



United States
Department of
Agriculture

Forest Service

Rocky Mountain
Region

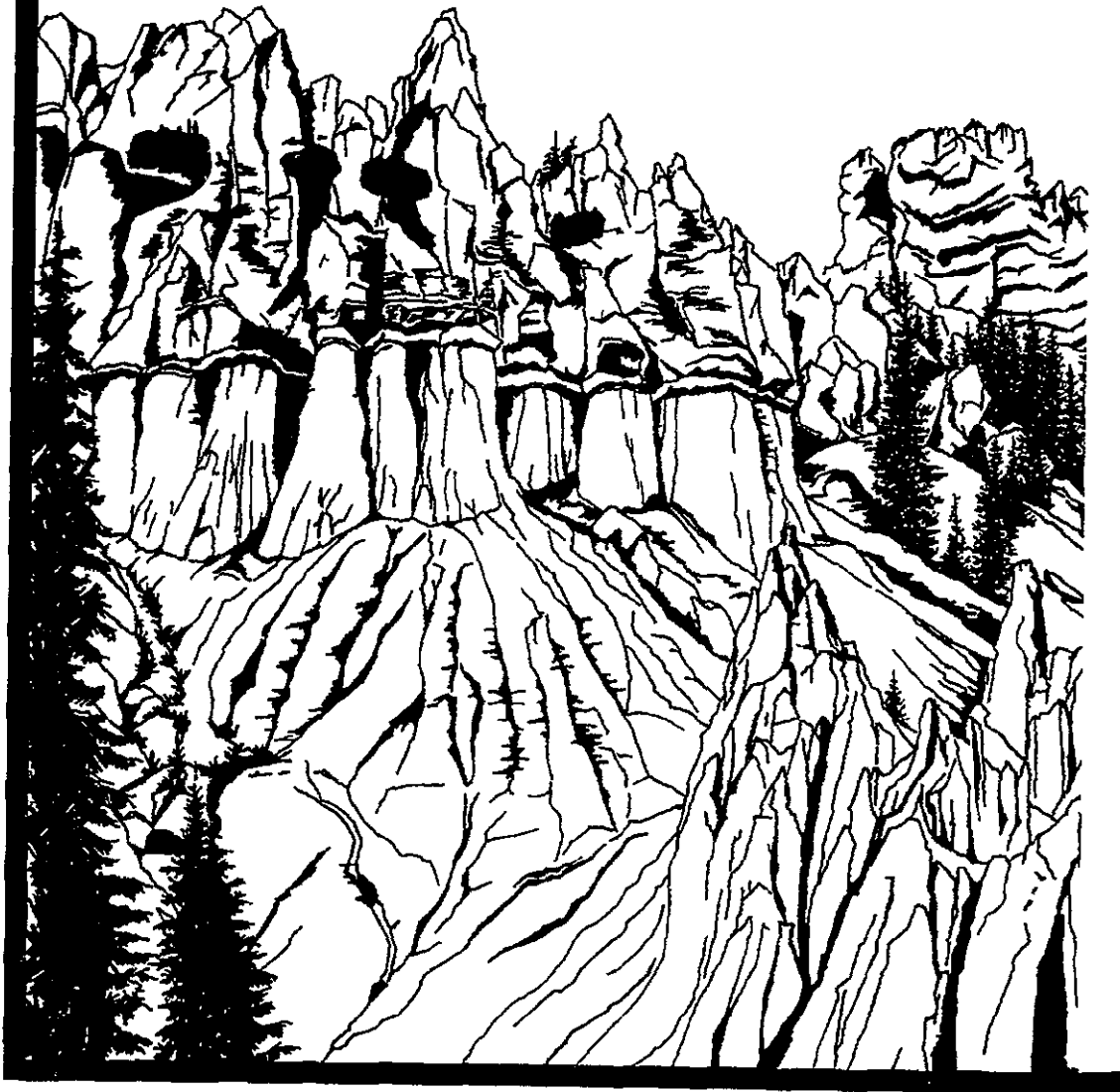
Rio Grande
National Forest



Appendices

Final Environmental Impact Statement

For the Revised
Land and Resource Management Plan

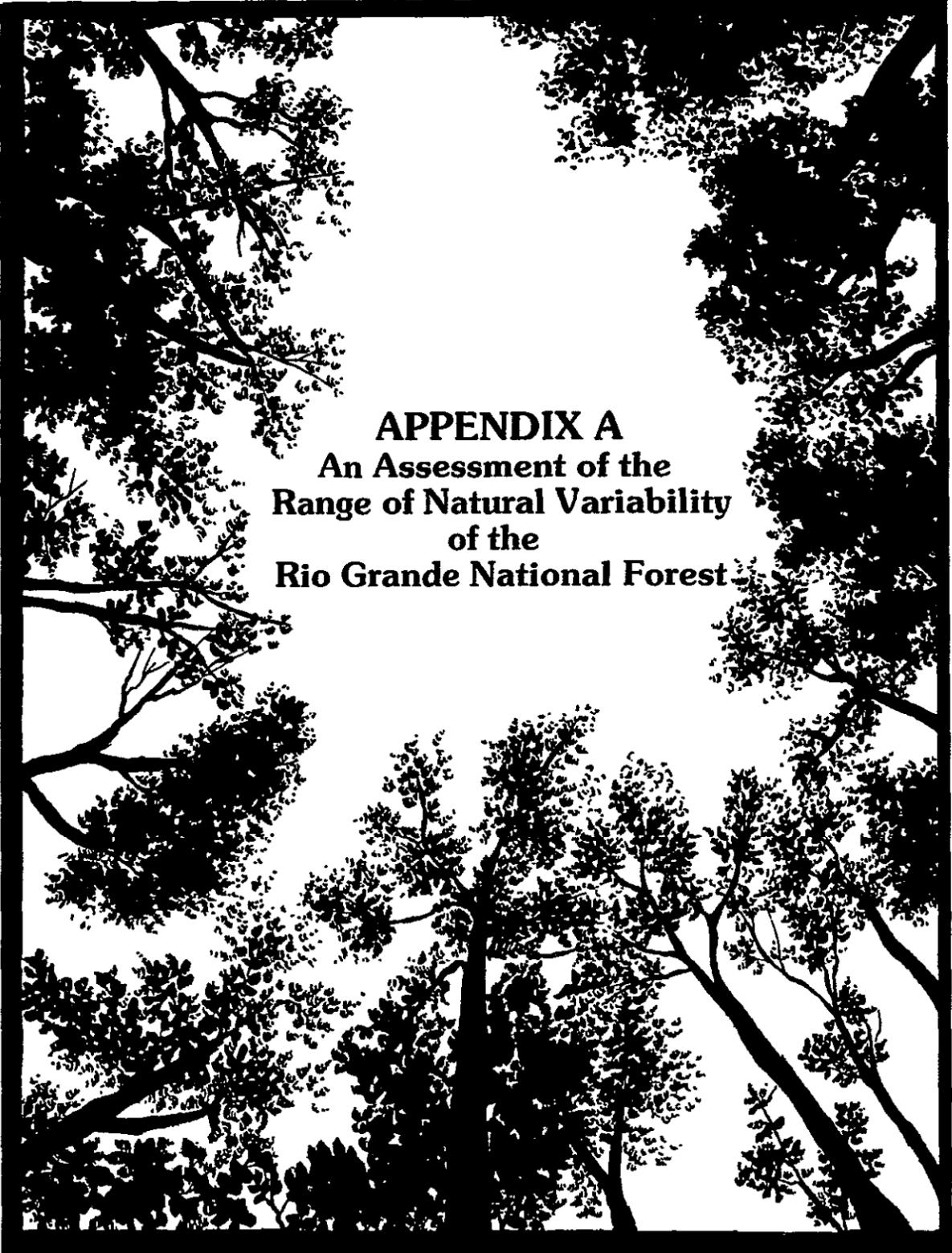


Rio Grande National Forest

FINAL ENVIRONMENTAL IMPACT STATEMENT

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APPENDIX A
An Assessment of the
Range of Natural Variability
of the
Rio Grande National Forest

APPENDIX A

An Assessment of the Range of Natural Variability of the Rio Grande National Forest

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APPENDIX A

An Assessment of the Range of Natural Variability of the Rio Grande National Forest

I. INTRODUCTION

The range of natural variability (RNV) for the Rio Grande National Forest (RGNF) will be based upon how the ecosystem functioned during the relatively stable period from 1600 to the early 1870's, just before modern settlement of the area. Accelerated human influence on the environment began in the late 1800's. Activities occurring during this time included the limited use of the land by past American Indian groups, early trappers and traders, early San Luis Valley (SLV) agricultural-based settlers, and people involved in early mining efforts.

Including humans as part of ecosystems is a current topic of public debate. Garcia (1993) says that "any valid ecological study must consider the human organism and be concerned with the ways in which humans relate to and affect their environment." This report acknowledges that humans are an integral part of ecosystems and are fully dependent on ecosystems for their well-being (Kaufmann et al. 1994). A section relating to human influences on RGNF ecosystems is presented to assess the scope of this influence.

This document assembles a description of the ecosystems on the RGNF from available historic information. An assessment of the Forest's range of natural variation attempts to pull available qualitative and quantitative data together and make inferences about the variability of the ecosystems. Since characteristics of most ecosystem elements are not well defined, a reliance on historic journals, historic photographs, and current scientific literature provides an incomplete depiction of pre-settlement conditions. The range of natural variability assessment, therefore, becomes more qualitative than quantitative.

Ideally, it would be helpful to know the upper and lower bounds of ecosystem characteristics to assess land management activity impacts at different scales. The assumption is that if activities create conditions exceeding the bounds of the range of natural variability, then the risk of perpetuating biological diversity and ecological function may rise. Ecosystems may not be naturally sustained where bounds are exceeded without further input of energy (USDA Forest Service 1992).

The basic objectives of this study are

- 1. To present historic information concerning ecologic conditions and human activities on the RGNF during the following periods:**

Initial Modern Climatic Conditions (13,000 B.C. to 1600 A.D.).

Limited Human-Induced Variability (1600 to 1875).

Initial Settlement and Growth (1875 to 1908)

Early Regulated Forest Management (1908 to 1950).

Late Regulated Forest Management (1950 to 1994)

2. **To make conclusions about the range of natural variability of the RGNF, taking human activity into account.**

II. METHODS AND LIMITATIONS

The process began with an intensive record search by individuals from the RGNF Forest Plan Revision Interdisciplinary (ID) Team. They reviewed historical files at the RGNF Supervisor's and District offices, including reports about resource projects, mining districts, Forest Reserves, RGNF history, range activities, silviculture, and archaeological excavations. They also reviewed official correspondence, agency bulletins, letters, newspaper articles, photographs, an Executive Order, magazine articles, and reports written by other agencies. Searches of area and regional libraries also yielded documents such as technical papers, historical publications, articles, journals, plant guides, theses, and photographs.

The ID Team quickly realized the limitations of the information. For many ecological processes there were no studies conducted specifically on the RGNF, therefore studies on adjacent areas were sometimes used to help draw conclusions. In addition, much of the information used is not from peer-reviewed sources; therefore, certain biases may exist in the information. Since characteristics of most ecosystem elements are not well defined, a reliance on historical journals, historic photographs, and current scientific literature provided an incomplete depiction of pre-settlement conditions.

III. SETTING

Elevation, Geology, and Climate

The RGNF, consisting of 1,851,792 acres, is located in south-central Colorado. Two mountain ranges on the RGNF form the backdrop for the San Luis Valley, one of the largest mountain basins in the world. Elevations range from 7,800 feet in the foothills to above 13,000 feet in the San Juan mountains, along the Continental Divide. Elevations in the Sangre de Cristo mountains sometimes exceed 14,000 feet. The headwaters of the Rio Grande originate on the RGNF and all watersheds drain into the Rio Grande system.

The San Luis Valley (SLV) is composed of unconsolidated sediments laid down in the late Tertiary Period (see Table A-2). The two mountain ranges on either side of the SLV are very different in origin and geology. The San Juan mountains, which are volcanic in origin, formed during the mid-to-late Tertiary Period. The Sangre de Cristo mountains, which make

up a long, steep, narrow range, were formed because of faulting and upthrusting along the Rio Grande rift.

The massive San Juan mountains cause a rain-shadow effect east of the Continental Divide. Consequently, the Sangre de Cristo range is drier than the San Juan range, and the SLV is a very dry high-mountain desert. The San Juan mountains have an annual precipitation of up to 50 inches in the wettest areas such as Wolf Creek Pass, Cumbres Pass, and the Conejos River uplands. Humidities are generally low in all locations.

Temperatures rarely exceed 90°F in the summer, while winter low temperatures of minus 25°F sometimes occur. Winter extremes can be minus-40° to minus-50°F. The frost-free growing season in the upper-elevation spruce/fir zone, which composes the majority of the land on the RGNF, ranges from 60 to 90 days. Weather during the growing season is characterized by scattered thunderstorms interspersed with plenty of sunshine.

IV. VEGETATION

Foothill Zone

The Foothill Zone is a mixture of grassland, rabbitbrush, mountain big sagebrush, mountain mahogany, pinyon pine, and occasionally, Gambel oak. Pinyon pine, the most prominent cover type in the Foothill Zone, covers approximately 4% of the forested portions of the RGNF. Pinyon pines will generally live up to 400 years.

Montane Zone

Douglas-fir and ponderosa pine are the dominant and characteristic trees here. Ponderosa pine generally grows in scattered, park-like stands with abundant grass growth of Arizona fescue and mountain muhly in the understory. Ponderosa pine stands are usually less than 215 years old. Douglas-fir intermingles with ponderosa pine on north-facing slopes and in ravines. With elevation gain, Douglas-fir eventually replaces the ponderosa pine. Douglas-fir trees are usually less than 335 years old.

Two important seral (a developmental stage in an ecological succession) species are aspen and lodgepole pine. Aspen generally grows on sites that are moister than sites supporting lodgepole pine. On the RGNF, 73% of the aspen stands are between 66 and 125 years old. Lodgepole pine are generally less than 275 years old. The RGNF represents the southern geographic range for lodgepole. White fir commonly occurs in the upper elevations of this Zone.

Subalpine Zone

In the upper Montane Zone, the forest becomes more dense and transcends into the Subalpine Zone. The Subalpine Zone is dominated by Engelmann spruce intermixed with subalpine fir. These two tree species form the most extensive forested cover type on the Forest. There are very few stands of Engelmann spruce that exceed 335 years old. Trees over 250 years are not uncommon for subalpine fir, but generally most are in the 150- to 200-year range. Arizona fescue and mountain muhly dominate areas that are too dry for

tree growth. Rocky slopes and dry, gravelly areas will often support limber pine and bristlecone pine

The Subalpine Zone is typically a dense, deep green expanse of forest. It is broken only by drainages, outcrops of rock, or fire disturbance. Aspen and lodgepole pine are the major seral species in this zone, due primarily to past natural fire disturbance. South-facing slopes, which are hotter and drier environments, will have stands of Thurber fescue grassland. The spruce/fir forest receives the most precipitation of all the forest types. A great quantity of snow falls in this zone, which accumulates all winter and lasts into early summer. The trees protect the snow from melting or blowing away. Because of this, there are plants adapted to high amounts of moisture and a cold environment. Rocky Mountain whortleberry typically forms dense mats and is adapted to the cool, moist environment under Engelmann spruce. Some very delicate, fragrant flowers, like wood-nymph, can be found in the spruce/fir forest.

Alpine Zone

A willow/sedge community often overlaps from the Subalpine Zone to the Alpine Zone. A tremendous variety of plants inhabit the Alpine and there is a profuse display of wildflowers in late June and July. Low-growing sedge, Kobresia, and forb (broad-leaved herbaceous plants) communities dominate the Alpine Zone.

Riparian Ecosystems

Each zone mentioned contains riparian ecosystems. Riparian areas are lush, green strips of vegetation between adjacent dry upland vegetation. Riparian areas exist around streams, springs, lakes, bogs, or wetlands. Overstory (the taller plants on the site) vegetation can be dominated by any of the conifer species discussed or by blue spruce, willow, alder, aspen, or cottonwood, depending on elevation. The understory (plants growing underneath the taller plants) may be dominated

Table A-1. Vegetation Zone and Dominant Plant Associations of the RGNF

Vegetation Zone	Plant Association
Alpine	Kobresia/forb sedge/forb willow/sedge
Subalpine	subalpine fir -- Engelmann spruce/Rocky Mountain whortleberry subalpine fir -- Engelmann spruce/common juniper Thurber fescue bristlecone pine/Thurber fescue subalpine fir -- Engelmann spruce/Rocky Mountain whortleberry -- twinflower
Montane	aspen/Thurber fescue* lodgepole pine/kinnikinnick* white fir -- Douglas-fir/common juniper white fir -- Douglas-fir/Arizona fescue tufted hairgrass -- sedge Arizona fescue -- mountain muhly white fir -- Douglas-fir/kinnikinnick Douglas fir/Arizona fescue ponderosa pine/Arizona fescue
Foothill	Gambel oak/mountain muhly mountain big sagebrush/Arizona fescue pinyon pine/mountain mahogany pinyon pine/mountain muhly western wheatgrass needle-and-thread
*also found in Subalpine Zone	

by a variety of sedge, bluegrass, reedgrass, bentgrass, tufted hairgrass, rush, or many other water-loving graminoid (grasses and grasslike plants) or water-loving forb species. Although riparian areas are generally only a very small percentage of the land area, they have high species diversity and density, and high productivity.

Plant Associations

Table A-1 displays some prominent plant associations. The vegetation zones are presented from the highest elevations to the lowest. The most extensive forested plant association is the subalpine fir/Engelmann spruce/Rocky Mountain whortleberry type. Since most forest vegetation is in mature structural stages (a developmental stage based on tree age and amount of cover they create) (See Table A-2), many of the forested plant communities are in a late-seral stage (one of the last stages before the climax community is reached)

Table A-2 shows the age-class distribution within some selected forest cover types. The percentage of land area within each cover type is provided for aspen, ponderosa pine, Douglas-fir, lodgepole pine, and Engelmann spruce/ subalpine fir. Clearly most of the aspen is around 100 years old, most of the ponderosa pine and Douglas-fir are in the 96-to-185 age classes; most of the lodgepole pine is in the 96-to-155 age classes, and the spruce/fir is clustered around the 126-to-215 age classes

Table A-2. Percent of Land Area, by Age Class, within Selected Forest Species
(From Resource Information System data base)

PERCENT OF LAND AREA BY FOREST-COVER TYPE					
Age Class (Years)	Aspen	Ponderosa Pine	Douglas-Fir	Lodgepole Pine	Spruce/ Fir *
0-35	9	6	3	2	5
36-65	8	2	1	<1	1
66-95	42	5	7	6	5
96-125	31	42	28	41	12
126-155	9	33	31	29	18
156-185	1	11	18	10	23
186-215	0	1	7	10	17
216-245	0	0	3	1	11
246-275	0	0	1	1	5
276-305	0	0	1	0	2
306-335	0	0	<1	0	1
336-365	0	0	0	0	<1
366-395	0	0	0	0	<1
	100%	100%	100%	100%	100%
* Spruce/fir -- refers to Engelmann spruce and subalpine fir					

Structural Classes

Figure A-1 displays structural classes for several forested types on the RGNF. Structural classes (SCs) are any of several development stages of tree stands described in terms of tree age and the extent of canopy closure they create. Generally, most of the RGNF is in the mature or late-successional structural classes. Structural Classes are unique combinations of Habitat Structural Stages (HSS). The combinations are HSS1 & 2=SC1, HSS3a=SC2, HSS3b & 3c=SC3, HSS4a=SC4, and HSS4b, 4c & 5=SC5.

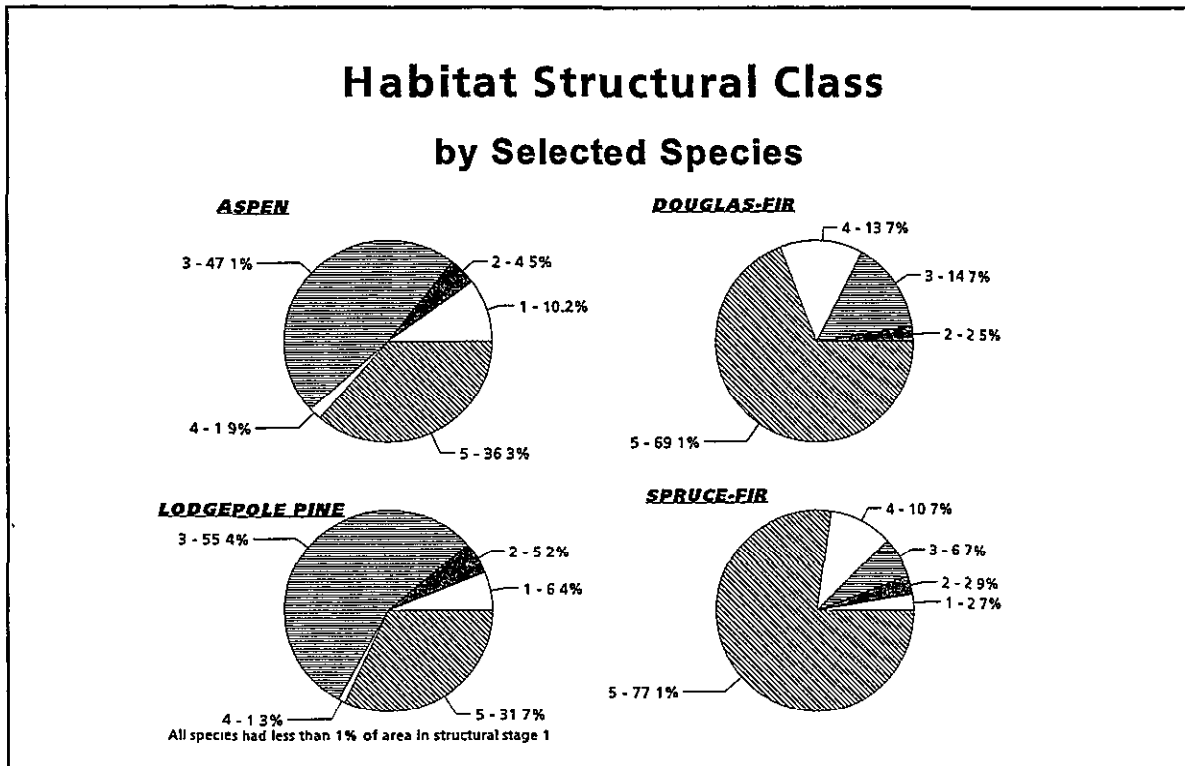


Figure A-1. Habitat Structural Class

- (1) -- GRASS/FORB/SEEDLING Stand dominance by grasses and forbs (broad-leaved herbaceous plants), shrubs and/or tree seedlings up to 1" diameter at Breast Height (DBH) -- 4.5' DBH for softwoods and 2" DBH for hardwoods
- (2) -- SAPLING-POLE. Stand dominance by trees in most of the 1-8.9" DBH size for softwoods and 2-8.9" DBH for hardwoods
- (3) -- SAPLING-POLE Same as (2) except canopy closure is 41-100%
- (4) -- MATURE Stand dominance by trees in most of the 9" or larger DBH size and tree age under 200 years for softwoods and under 100 years for hardwoods. Canopy closure is 40% or less
- (5) -- LATE-SUCCESSIONAL FOREST Two conditions are possible for meeting this category: Stand dominance by trees in most of the 9" or larger DBH size and tree age under 200 years for softwoods and under 100 years for hardwoods, with a canopy closure greater than 40%. Or stand dominance by trees in most of the 5" or larger DBH size and tree age under 200 years for softwoods and under 100 years for hardwoods, with a crown cover over 70%.

V. HISTORICAL BACKGROUND

Prehistoric/Historic American Indian Occupation

The SLV and RGNF are rich in history relating to the first settlement of Colorado. People of Paleo-Indian cultures were the first known inhabitants of the area. These and following cultures lived by hunting and gathering a variety of plants. People were few and their residence seasonal in all prehistoric periods (Horn 1990, Guthrie et al. 1984, Schroeder 1965).

Prehistoric is defined as the time before written history. Historic is the time after written history began; historic times in the SLV began around 1600 when the first Spanish explorers arrived. The prehistoric/historic series of American Indian cultures of the RGNF and the SLV spans a period from approximately 10,000 B.C. to A.D. 1881. Use of the area by the following cultures has been identified:

- 1) **Paleo-Indian Tradition (10,000 B.C. to 5,500 B.C.)** The Clovis culture group, who inhabited the San Luis Valley between 10,000 B.C. and 9,000 B.C., concentrated on hunting the now-extinct mammoth. Artifacts associated with people of the Folsom Period, dating to 8,500 B.C., are found in the SLV, but rarely on the RGNF. Folsom people hunted a now-extinct form of bison.
- 2) **Archaic Stage (5,500 B.C. to 500 A.D.)** People of the Archaic Stage used a variety of plants and animals while traveling in extended family groups of 30 to 60 people. Artifacts found suggest an influence from the south and southwest.
- 3) **Late Prehistoric/Historic Aboriginal Stage (A.D. 500 to 1881 A.D.)** These people lived by hunting and gathering in extended family groups. Cultures of this stage included the Ute, the oldest continuous residents, of what is now Colorado. Arriving as early as 1300 A.D., the Ute became the primary seasonal inhabitants of the area. By 1881 they were moved to small reservations in southwestern Colorado and Utah.

The Comanche, Navajo, Apache, Jicarilla Apache, Sioux, Cheyenne, Kiowa, and Arapaho are thought to have been visitors to the San Luis Valley area during this stage to hunt, trade, or raid.

FIGURE A-2. AMERICAN INDIAN CULTURAL HISTORY SEQUENCE
FOR THE SAN LUIS VALLEY AND VICINITY

DATE	CULTURAL PERIOD	NAME OF CULTURE
A.D. 1900		
A.D. 1800	<i>Historic Aboriginal Stage</i>	<i>Ute</i>
A.D. 1700		
A.D. 1600		
A.D. 1500		
A.D. 1400	<i>Late Prehistoric Stage</i>	<i>Ute</i>
A.D. 1300		<i>Ceramic (Limited)</i>
A.D. 1000		
A.D. 500		
2000 B.C.		<i>Late Archaic</i>
3000 B.C.	<i>Archaic Stage</i>	<i>Picosa</i>
4000 B.C.		
5500 B.C.		<i>Rio Grande</i>
6000 B.C.		<i>Plano</i>
7000 B.C.	<i>Paleo-Indian Tradition</i>	
8000 B.C.		<i>Folsom</i>
9000 B.C.		<i>Clovis</i>
10000 B.C.		

Hispanic and Anglo Settlement

Extremely limited Spanish entrance into south-central Colorado began in 1765 by explorers looking for gold and silver. Fur trapping, an important activity from the early 1820's until the 1840's, preceded permanent settlement (Rosenberg 1976).

Trying to promote settlement in the 1830's and 1840's, Mexico established several large land grants of from 100,000 to almost 1,000,000 acres. The grants were given to families, mostly from New Mexico (Mehls and Carter 1984). The land grants remained virtually unsettled until the area became American Territory in 1848. San Luis de la Culebra, the first permanent settlement in Colorado, was established in 1851 on the Sangre de Cristo Grant. To protect the early settlements, Fort Massachusetts was established north of San Luis in 1852. More extensive commercial farming began in the 1880's, near Hooper and Monte Vista, where large-scale irrigation systems were built (Rosenberg 1976).

Significant mining development began in 1870 when gold was discovered near Summitville. Del Norte, established in 1872, served as a supply point and gateway to the San Juan mining camps. Other mining settlements followed in the 1880's and 1890's at Bonanza, Creede, Platoro, and along the Sangre de Cristo Mountains (Rosenberg 1976).

Roads

The mining rush to Silverton began in 1871, with the main route being over Stony Pass, west of Creede. Stony Pass was then only a trail and was not made passable to wagons until 1879 (Ridgway 1939). Toll roads were built under charters from the State to serve the many mining communities. The road from Antelope Park to Del Norte was chartered in 1875 (Richmond 1969). By 1875 the road from Del Norte to Summitville, following Pinos Creek, was improved to accommodate wagons. In 1888 the road was extended to Platoro, where it joined the military wagon road, built in 1878, from Ojo Caliente to Pagosa Springs (Rosenberg 1976). The road went up Cat Creek, to the Alamosa River, to the summit at Elwood Pass, and down to the East Fork of the San Juan River (Denver Tribune 1878). The toll road up the Conejos River to Platoro was developed in 1884. Crossing Stunner Pass it linked with the military wagon road (Rosenberg 1976). The road from Villa Grove to Saguache and from Bonanza to Shirley was built in the 1890's (Kortright 1945). By 1903 it was reported that "good wagon roads lead into the mountains along nearly every creek" (DuBois 1903).

Administrative History of the RGNF

Presidential Proclamations in June 1905 created the San Juan Forest Reserve, the San Isabel Forest Reserve, and the Cochetopah [sic] Forest Reserve. Portions of these reserves

Table A-3. Acreage Additions to the RGNF

Date	Acreage	Addition
1908	1,250,000	Original Forest Acreage
1945	400,000	Saguache and Carnero Creek drainages
1954	250,000	Sangre de Cristo mountains
	1,900,000 approximate acres	

were combined to form the RGNF on July 1, 1908 (Colorado Division of Water Resources N.D), with a total land base of 1,252,158 acres (Executive Order 1908).

The original RGNF consisted of the parts of the San Juan and Cochetopa National Forests within the Rio Grande drainage, excluding the land around Saguache Creek, the tributaries of Carnero Creek, and the tributaries of San Luis Creek. Approximately 400,000 acres of land in the Saguache and Carnero Creek drainages were added from the Cochetopa National Forest in 1945. Approximately 250,000 acres on the west side of the Sangre de Cristo Mountains were added to the RGNF from the San Isabel National Forest in 1954 (Colorado Division of Water Resources N D)

VI. CLIMATE

13,000 B.C. to 1600 A.D.

As the Pleistocene era, also known as the Ice Age, ended and the Holocene era began (around 13,000 B.C.) the glaciers of Colorado's Rocky Mountains were rapidly melting and retreating to higher elevations (Malde 1964). Estimates are that by 11,500 B.C. the average July temperature had warmed to around 5°C cooler than present (Carrara et al 1984). Pollen records suggest that the climate had already become dry at the time of the Clovis Paleo-Indian occupation of North America, at 10,000 B.C. (Malde 1964)

From about 7,500 B.C. to 1,000 B.C. the climate in the San Juan Mountains was generally warmer than present (Carrara et al 1984). The driest portion of the Holocene era was from 4,000 B.C. to 2,500 B.C. (Malde 1964). During the last 10,000 years, climatic conditions have fluctuated enough to produce at least five changes in tree line in the San Juan mountains (U.S. Bureau of Reclamation 1973). These climatic shifts did not cause any extensive glaciation (U.S. Bureau of Reclamation 1973)

Around 1,000 B.C., a general period of cooling began in the San Juan Mountains (Carrara et al 1984)

Cool and moist periods, of approximately 200-year durations, interrupted by shorter warm and dry periods, averaging 55 years, occurred from 375 A.D. to 1400 A.D. (Eddy et al 1984). These periods can be seen in Table A-4

1600 to 1875

A general cooling trend began about 1550 and lasted until 1850, with colder, moister conditions prevailing. Cycles of cooling, with increased precipitation, and warming,

Table A-4. Southwest Climate Cycles

PERIOD	CLIMATE
A D 375 to 580	Cool and Moist
A D 580 TO 620	Warm and Dry
A D 620 to 850	Cool and Moist
A D 850 to 920	Warm and Dry
A D 920 to 1130	Cool and Moist
A D 1130 to 1170	Warm and Dry
A D 1170 to 1400	Cool and Moist
A D 1400 to 1470	Warm and Dry

with declining precipitation, occurred during this period (Hurlbett N.D.) From 1770 to 1800 there was a general long-term drought (Mangimelli 1990). Temperatures appear to have risen sharply from 1850 to 1867 (Kindquist 1987) with a significant period of abnormally warm and dry conditions between 1850 and 1855 (Mangimelli 1990).

1875 to 1908

Temperatures appear to have declined through the 1890's and into the 20th century (Kindquist 1987) while "significant intervals of abnormally cool and moist conditions occurred from 1885 through 1908" (Mangimelli 1990).

1908 to 1950

Mangimelli (1990) says that the general cool and moist period, which began in 1885, lasted until 1925. At Wagon Wheel Gap, near Creede, a cool and moist period was documented from 1911 to 1924. This period was characterized as moderately cool and wet with the excess in precipitation from normal averaging 1.34 inches per year and the temperature abnormality (annual means considered) 0.7° F below normal (Bates and Henry 1928). Temperatures appear to have increased by 1930 to the 1950's (Kindquist 1987).

1950 to 1994

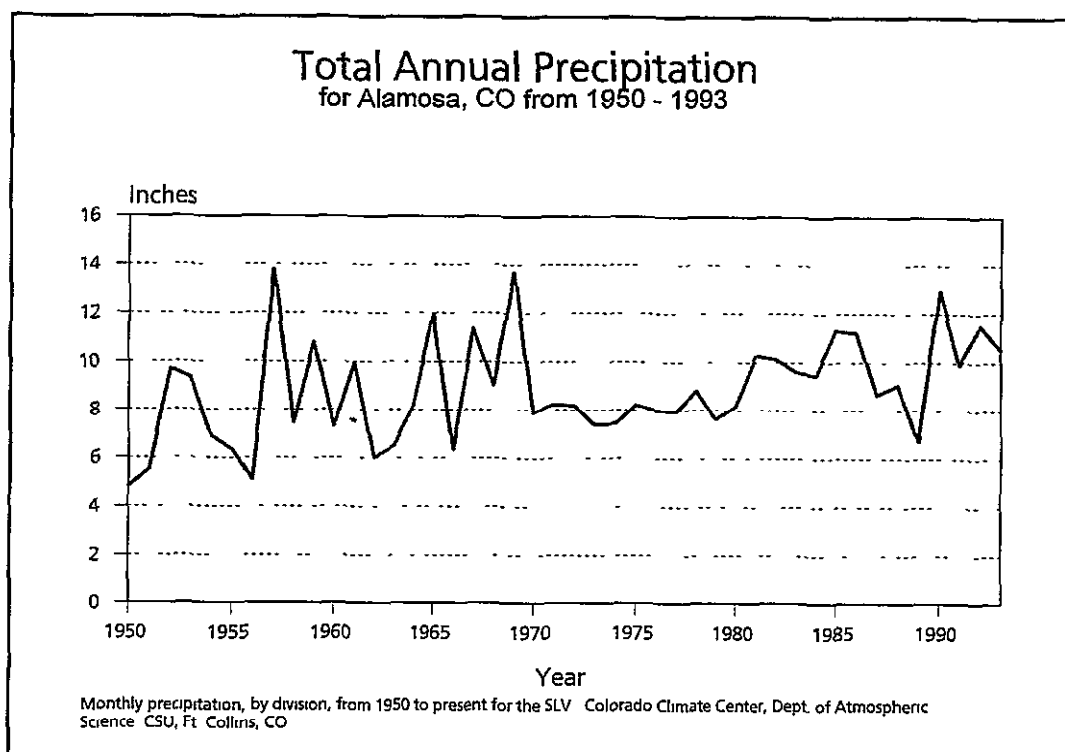


Figure A-3. Total Annual Precipitation

VII. FIRE HISTORY

Terminology

A natural fire regime refers to the overall pattern of fires in vegetation, over time, that is characteristic of a natural region or ecosystem. The fire regime includes variations in ignition, fire intensity and behavior, how often fires of that size recur (or the return interval), and ecological effects. Important elements include:

- ▶ fire type, intensity, and size or area,
- ▶ fire frequency or length of "return intervals" for any given point on the ground, such as an individual tree or a stand of trees,
- ▶ frequency for the whole ecosystem, termed the natural fire rotation or fire cycle. It is defined as the average time required for a natural fire regime to burn over an area equivalent to the total area of an ecosystem. (Need to simplify!)

Fire by Cover Type

The Engelmann spruce/subalpine fir cover type is usually characterized by infrequent and often high-intensity surface fires with more than a 50-year return interval. These severe, infrequent fires usually occur in combination with long return-interval (100-300 year), sporadic crown fires and/or higher-intensity surface fires that kill most, but not all, vegetation. Many of these long-return interval fires will cover medium to large areas (1,000 to 10,000 acres) (Mutch 1991).

The spruce/fir cover type exhibits some of the slowest and most variable successional trends. Many 100- to 150-year old burns are still not showing any indications of conifer or aspen reestablishment and are maintaining a grass cover. The most common pioneer tree species are aspen and lodgepole pine. Which species will first regenerate a burned site depends on many factors, including severity/intensity of the fire, seed-source availability, the presence and health of aspen, and weather conditions following the fire. The more shade-tolerant spruce will begin regenerating under pioneer trees, but it can be very slow, particularly if a dense lodgepole stand becomes established.

In the mid-elevation (7,800' to 9,500') mixed-conifer cover type, mature to older forests may vary greatly in species composition. Douglas-fir is the dominant species most often found in mid-elevation areas, while at lower elevations or drier sites, ponderosa pine is the codominant, with lodgepole pine also apparent. As moisture increases, more lodgepole pine, aspen, and/or Engelmann spruce/subalpine fir will share the site with Douglas-fir.

Determining fire effects and regimes for all the various permutations of these combinations would be overwhelming, but generally, the regime is one of frequent light-surface fires (5- to 25- year intervals). These are often combined with sporadic small-scale, long- or very long-interval crown fires and/or high-intensity surface fires. Acreages vary from 200 to 5000 acres (Mutch 1991).

A prime factor in determining whether the more shade-tolerant species (that is, late-seral) will become established is the frequency of fires. At lower elevations, "thinning" fires

would favor ponderosa pine over Douglas-fir. This is because Douglas-fir regeneration would be killed before it was of sufficient size to withstand even minimal flame. This also contributes to the ponderosa pine's vigor by reducing competition for sunlight, water, and nutrients.

Higher and moister sites become more "complicated" due to the involved species' sensitivity to fire. Older Douglas-fir can withstand moderate surface fires, but the crowns are very sensitive. Lodgepole pine is always "at the door," looking for a chance to fill voids left by crown fires or surface fires that kill the overstory through scorching.

There are many areas throughout the RGNF that exist in this "state of flux." The location and type of fire that occurs here will determine whether Douglas-fir will continue to migrate downslope on to ponderosa pine sites, or whether spruce-fir will continue to expand on to upper-elevation sites held by Douglas-fir and lodgepole pine due to a previous fire.

1875 to 1908

Causes of Forest Fires

Human-caused fires before 1870 were sometimes attributed to American Indians (Agee 1924, RGNF 1953). In 1869 there were approximately 2,500 Ute people in the SLV and surrounding mountains (Schroeder 1965). The low population would have probably limited the overall effect of American Indian-caused forest fires.

After 1870 many fires were attributed to miners (Agee 1924). Five major fires in the Creede area were said to have been set by them, to make ore-producing veins easier to view, including East Willow Creek, Wason Park, Deep Creek, Copper Mountain, and Fisher Mountain (Wyley 1993). In 1893, the year of the silver panic, many fires were started as miners left Colorado due to poor economic conditions (Agee 1924).

Other fires were attributed to sheepherders, who set them to improve forage (Agee 1924). Dubois (1903) said that "it is safe to say that 75% of the fires are set, either accidentally [sic] or intentionally, by sheepherders." From the 1870's to the 1890's, the vicinity of La Jara Meadows, on the Conejos Peak Ranger District, was burned to free the area of underbrush before lambing (RGNF 1953). Cattle ranchers were known to set fires to keep their cattle away from larkspur, a poisonous plant (Agee 1924).

Fires were sometimes associated with railroad activity. It is believed that railroad crews probably started the Osier Mountain fire of 1879, which burned about 30,000 acres of what is now the Conejos Peak Ranger District (RGNF 1970, RGNF 1953).

Table A-5. Large Fires on the RGNF from 1873 to 1903

DATE	NAME OF FIRE	ESTIMATED SIZE/LOCATION
1872	La Garita Creek	10,000 acres
1873	Jasper/Burnt Creeks	4,000 acres
1875	Alamosa Canyon (Stunner)	15,000 acres
1876	Chama Basin	10,000 acres
1879	Osier (Cumbres Pass)	30,000 acres
1881	Goose Creek	Elk, Raspberry, Trout, Leopard, and Goose Creeks
1893	Rock Creek	Entire North Rock Creek watershed
1893	Saguache Creek	Head of Saguache Creek
1893	Willow Creeks	East and West Willow, Shallow, and the vicinity of Bachelor
1900	Klondike Mountain	Adams Fork, Klondike Mountain, and Globe Creek
1900	Tie Hill	Extensive area of Decker, Goodrich, and Lake Fork Creeks
1905	Wagon Wheel Gap	North side of the Rio Grande

Forest Fire Suppression

Fires were generally allowed to burn unless they were small or they threatened private land (Agee 1924). Occasionally forest fires were fought (RGNF 1926), but this was not the rule. In 1908 when the RGNF was established there was a new emphasis placed on controlling forest fires (RGNF 1968).

The following statement suggests the effect of fire prevention and suppression on forest composition and structure after the Forest was formed. "The care taken to prevent forest fires, due to lightning and other causes, bids fair in time to clothe some of the mountains with a heavier forest growth than they had when the white man came" (Barler 1924).

Revegetation of Burned Areas

Restocking of burned areas was very slow, large expanses of grass were found within areas of burned Engelmann spruce (RGNF 1908). High-altitude burns were very slow in restocking, and DuBois (1903) says that typically, after 10 years there were "here and there, scrubby spruce seedlings and a dense mat of grass which greatly retards reproduction." Aspen soon regenerated burns at elevations up to 11,000', but failed to regrow at higher elevations (RGNF 1953).

1908 to 1950

There is a general lack of information about this period, however, from 1944 to 1949 there were 65 fires that burned approximately 320 acres. Lightning caused 25 of them and humans 40.

1950 to 1994

From 1950 to 1994 there were 735 fires that burned approximately 3,060 acres. The largest fires occurred in 1953 (700 acres), 1960 (350), 1971 (150), and 1974 (700). The average fire size was about 4 acres. An active fire-suppression program was in effect. From 1970 to 1994 there were 149 human-caused fires resulting in 1,029 burned acres and 264 lightning-caused fires burned 206 acres.

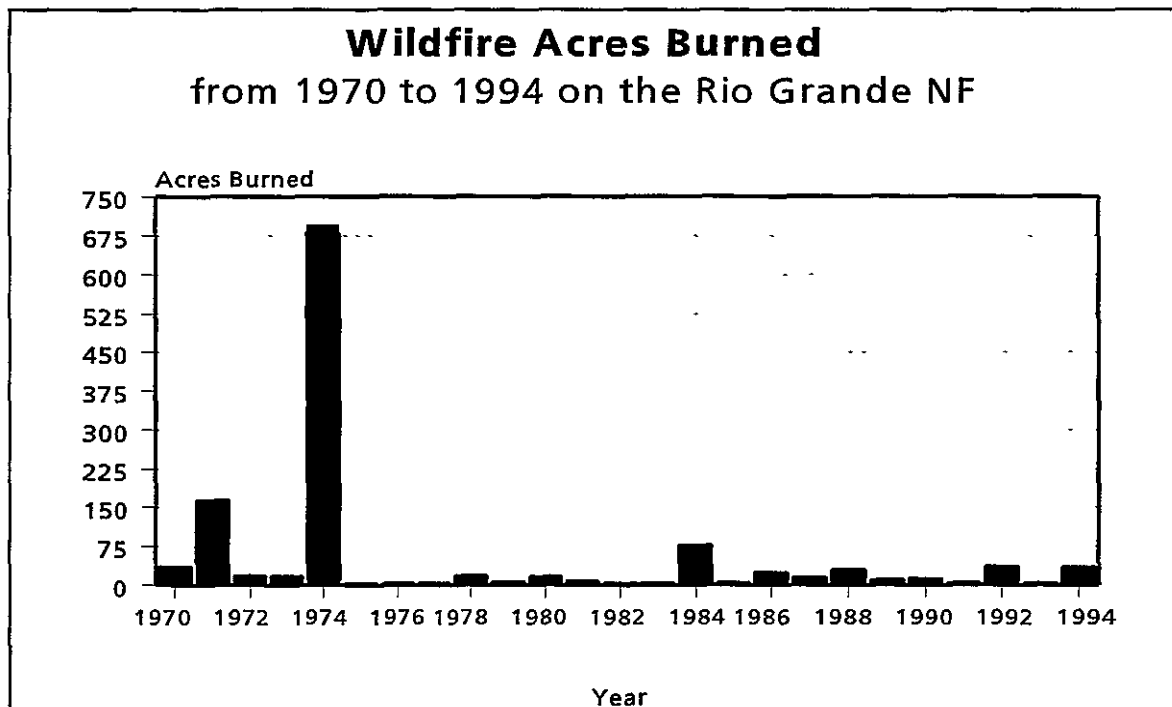


Figure A-4. Wildfire Acres Burned from 1970 to 1994 on the Rio Grande NF

Fire Frequency

Foothill Zone

Crane (1982) states that the Foothill Zone may have burned an average of every 5 to 30 years. Since pinyon pine is susceptible to fire, especially under 4', the present range has probably expanded due to past fire suppression (Dwyer and Pieper 1967). Wright (1990) mentions that Gambel oak may have burned every 50 to 100 years, but stresses that this is

speculative Fires in Gambel oak are often spotty and irregular. They also only occur after a buildup of litter and a dry period.

Montane Zone

Historically, frequent low-intensity fires removed competing understory vegetation and down material. The result was irregular-shaped stands of uneven-aged trees, varying in size from a few trees to several acres Pure stands of Douglas-fir originated from fire, but could resist subsequent low-intensity fires due to the species' rapid growth, thick, corky bark, and ability to form adventitious roots (roots produced on stems or on various types of leaves) Older Douglas-fir stands are rarely more than 400 years of age, although some may reach an age of 700 years if stand-replacing fires are excluded. Douglas-fir stands are usually less than 335 years old The abundance of white fir increases in the upper elevations of this Zone, in what is often termed mixed-conifer type. Historically, fires have tended to reduce the abundance of white fir; Douglas-fir is much more resistant to fire than white fir.

Two important seral-community species of the Montane Zone are aspen and lodgepole pine Aspen and lodgepole pine can replace ponderosa pine and Douglas-fir forests where disturbances, including fire, have removed the Douglas-fir. Sometimes, if a burn is severe and large enough, aspen or lodgepole pine can become a climax community The average life span of lodgepole pine is probably 250 years or less because of past stand-replacing disturbances, such as fire Lodgepole pine stands are generally less than 275 years old (see Table 1-1).

Crane (1982), Wright (1990), Stokes and Dieterich (1980), and Dr Phil Omi of Colorado State University (Omi, Personal Communication 1992) suggest the following natural fire frequencies from other Western research done 5-20 years in dry ponderosa pine stands, 7-25 years in wet ponderosa pine stands, 10-50 years in dry mixed-conifer stands, and 30-150 years in wet mixed-conifer stands The frequent low-intensity fires that were common in ponderosa pine have generally been stopped through fire suppression This may be allowing Douglas-fir to become established and increase its range at lower elevations in this Zone This increases the probability of large, stand-replacing fires, due to the effects of fire-suppression activities

Subalpine Zone

Crane (1982), Stokes and Dieterich (1980), and Dr Phil Omi of Colorado State University (Omi Personal Communication 1992) suggest that the natural fire frequency ranges from 100 to 500 years in the Subalpine Zone Old-growth stands in the Subalpine Zone were probably subjected to sporadic, low- to moderate-severity disturbances, including fire Aspen and lodgepole are the major seral species in the Subalpine Zone, due primarily to past natural fire disturbance

Summary and Conclusions: Fire

The period of initial settlement and growth, 1875 to 1908, provides the most visible and intensely researched indicators of fire effects on vegetative structure Concentrating on this period may show a bias toward person-caused ignitions due to the influx of settlers; however, the ignition source, be it lightning or people, is unimportant when thinking on a landscape and ecosystem time scale The most determining factor in whether an ignition develops into a large, stand-altering fire is the weather -- or, more appropriately, the

climate. The correlation between long-term climatological fluctuations and major fires seems much stronger than that between ignition source/type and major fires. Comparison of weather/climate indicator graphs (RGNF 1953) and the Great Sand Dunes National Monument tree-ring-indices analysis (Mangimelli 1982) with the historical large-fire-occurrence study (RGNF 1991) suggests a very strong correlation of large fires to periods of unusual dryness. In other words, chances are these fires would have occurred under the prevailing weather/climate conditions no matter whether they were ignited naturally or by people.

Human-caused ignitions have probably altered the fire regime/cycle, and the RNV, in various ways. The actual location of the ignition, whether of natural or human origin, may have influenced the size and intensity of fires. For example, most human ignitions began in the lowlands or at the base of drainages. Fires starting in low elevations can, under the right conditions, race upslope, consuming most of the available fuel. In contrast, lightning strikes most often occur higher up on a ridge. These fires progress slowly downhill through surface spread and rolling debris. They may eventually reach the bottom of drainages or steep slopes, where, under the right conditions, the fire may run back up the slope.

Additionally, the influx of humans and the apparent increase in fires from 1875-1908 indicates a disruption of the fire regime or cycle, more on the temporal scale than on the spatial. Through the combination of climate, fuels, and ignition source that form the fire regime for the predominantly spruce/fir areas, most of these affected drainages and west-to-southwest-facing slopes would have eventually burned. The increased ignitions from humans have greatly shortened the occurrence intervals. Under natural conditions, these intervals would have been more spread out. If the natural fire frequency had remained uninterrupted by the 1875-1908 influx of humans, then the acreage of land in the 100- to 150-year post-fire recovery stage would probably have been lower.

The effects humans have had on the fire regimes/cycles during what has been called the "Suppression Era" (1910 to the present) are less obvious, but potentially more damaging. This is especially true in the short-interval fire-adapted stands, which are usually warm/dry, long-needle pine types. These sites are conditioned to low-intensity surface fires at frequent intervals. These fires clean up the forest floor, reduce competition, and prepare natural seedbeds (USDA 1993). These stands of mainly ponderosa pine and/or ponderosa pine/Douglas-fir are affected more dramatically, and faster, by suppression of natural fires than are the more predominant RGNF cover type of Engelmann spruce/subalpine fir.

Not allowing natural fires to burn in these short-interval cover types allows the more shade-tolerant, fire-intolerant Douglas-fir to move into ponderosa pine sites, where it may eventually displace the ponderosa pine. Additionally, the increased fuel loading from dense regeneration and natural dead-and-down accumulation predisposes the site for high-intensity, stand-replacing fires.

The actual successional sequence in any given stand depends upon many variables. The most important of these include the pre-burn vegetation; the size, intensity, and severity of the fire; the climatic, topographic, and soil factors; and chance. This report focuses on the major cover types or landtype associations.

VIII. FORESTED COMMUNITIES

13,000 B.C. to 1600 A.D.

Generally, by 8,000 B.C., plant communities in the New World were being replaced with communities similar to the present potential vegetation (Jelinek 1967). However, the climate fluctuated enough to produce at least five periods of significant tree-line migration during the last 10,000 years in the San Juan Mountains (US Bureau of Reclamation 1973). From around 7,600 B.C. to 5,700 B.C., from 4,700 B.C. to 3,600 B.C., and about 1,100 B.C., the tree limit was at least 70 meters (229 feet) higher than present (Carrara 1984) suggesting temperatures were warmer.

Determination of past vegetation is often done using pollen analysis. This involves drilling a core in the ground and analyzing the pollen in the soil. A pollen analysis of an archaeological site at 11,000 feet on the Continental Divide in south-central Colorado suggests that spruce (*Picea*) has occupied this site in a similar density since at least 2,900 B.C. Other tree pollen include: maple, alder, birch, juniper, Douglas-fir, aspen, and willow (Scott N.D.).

Historic Use of Forest Products

American Indians of the Paleo-Indian period (see Table A-2) used a variety of available plant resources to supplement their diet of large game (Guthrie et al. 1984). The very low density of people probably limited the effects of these gathering activities on forested communities (Horn 1990). Expanding populations and the associated increased use of vegetative resources by the people of the Archaic period would have increased the effects, although not much (SJNF 1984). The use of wood products, such as logs, was probably extremely limited because people lived at temporary campsites (SJNF 1984).

1600 A.D. to 1875 A.D.

Influence of Climatic Conditions

Tree-ring records from Arizona and New Mexico show a drought occurred about 1600, killing many coniferous trees growing at low elevations. From 1600 to 1800, the forests are thought to have expanded around small stands of older trees (Malde 1964). Pollen-record studies in the La Plata Mountains in southwest Colorado, at 10,040', suggest there was an expansion of spruce and pine down the mountain within this period (Peterson 1987) indicating cooler/wetter conditions prevailed.

Historic References to Forested Condition

Some general statements concerning the condition of the forest were made by visitors to the area:

- ▶ Jacob Fowler, a frontiersman, trapper, and trader, who kept a journal while on a trading expedition in 1821 and 1822, said that near the present site of Del Norte "short pines" were abundant on the surrounding hills (Coues 1970).

- ▶ During the John Charles Fremont Expedition of 1848, Benjamin Kern noted that Mosca Pass had aspen and pines, the latter burned to a great extent (Hafen 1960). Another Fremont diary notes that the timber in Mosca Creek was windthrown, implying that there was at least large mature and older timber there. In the Alder Creek area, there were aspen and pine and brush 8' - 10' high (Brandon 1955)
- ▶ In 1873, members of the Ruffner party described the foothills just up the Rio Grande from Del Norte as being sparsely timbered with small pinyons and junipers. Their account said that "farther back in the mountains there seems to be fair-pine timber" and the gulches contained "much good-pine timber." Between Del Norte and present South Fork, along the Rio Grande, "clusters of well-grown yellow pine trees" were noted; the terraces above the Rio Grande, about 30 to 40 miles above Del Norte, had some small pine. The land south of the Rio Grande, in the Wagon Wheel Gap area near Creede, was "heavily timbered to the visible summit." On the north side of the river the mountains were "nearly timberless." The mountains south of Clear Creek valley were timbered to the summit. (U.S. Congress 1874).
- ▶ Ruffner also explored Cochetopa Pass, saying that "some yellow pine is found, of no great size, and occasionally spruce and aspen." In addition, photographer William Henry Jackson, in 1873, mentioned areas with heavy downed timber and heavy underbrush which was frequently impassible (Hafen 1959)

Historic Use of Forest Products

Use of wood products by American Indians during this period was probably limited due to their low population and seasonal occupation. Small amounts of standing dead pole-sized timber were probably used for temporary habitation structures, and other materials, such as bark, were probably used for a variety of purposes.

Early Hispanic settlers in northern New Mexico used pine as the main furniture wood, pinyon for saddles, cottonwood for kitchen utensils, juniper for looms and beams, Douglas-fir for plows and dimension lumber, and aspen for musical instruments. All these species were probably also used for firewood. White fir, limber pine, blue spruce, and Engelmann spruce were little used because they grow at high elevations and were not as suitable as the other woods. Fences were uncommon during this early period so little wood was needed for this purpose (Jones 1932).

From 1850 to 1875, a similar use of wood was made by the early Hispanic settlers of the SLV. Their effect on forested communities was probably minimal due to their low population and correspondingly small use of resources. They mostly used resources found at lower elevations of the RGNF, located near early settlements such as Antonito and Del Norte.

1875 to 1908

Descriptions of forested communities during the early portion of this period are lacking. In 1903, Coert Dubois published a study concerning the condition of forested communities immediately before 1903. The study included part of the present RGNF before the formation of the San Juan Forest Reserve.

Forested Communities as Described by Dubois in 1903

Dubois (1903) describes the land now within the RGNF as having been repeatedly burned, except for stands of Engelmann spruce at the heads of creeks. Since aspen typically moves in after a fire, these fires resulted in aspen stands of varying ages, containing scattering small bodies of conifers. He also observed much down timber and thick underbrush. In addition he noted that:

- ▶ At timberline, the trees consisted of scattered, stunted Engelmann spruce, often 10" in diameter and 4' - 5' high. A belt of pure Engelmann spruce, averaging 10" - 12" in diameter and 30' - 40' high, was found below the stunted spruce. It was growing very openly and limby to the ground.
- ▶ A dense stand of Engelmann spruce and subalpine fir, with spruce forming about 60% of the mixture, was found below the open belt of spruce. The trees averaged 14" in diameter and 75' high, although many along the bottoms of drainages and on north slopes reached 24" in diameter and a height of 110'. Twenty percent were standing dry trees, and there was a great amount of down timber. Most of the south slopes east of Hogback Mesa were covered with a scattering growth of twisted bristlecone pine growing from 9,500' to timberline.
- ▶ Openings, caused by fire or windfall, regenerated to aspen. Therefore, in the subalpine type, large areas of pure even-aged aspen were found. They varied, according to age, from 2" to 2' in diameter and from 4' - 30' in height. Aspen was found scattered singly in conifer stands, in small pure groups, and even-aged over large areas, forming about 30% of the mixture in the subalpine forest.
- ▶ Douglas-fir developed best on the south slopes and dry soil of the lower edge of the subalpine forest. Individuals growing there were sometimes 30" in diameter and 100' high. They were mainly found in groups of large poles 12" - 15" in diameter. The reproduction was scanty. White fir was found mixed with Douglas-fir and aspen on the lower north slopes. They sometimes reached a diameter of 30" and a height of 115'. Ponderosa pine were scattered over the south slopes (Dubois 1903).

Historic Use of Forest Products

Logging, to obtain railroad ties, occurred in the late 1870's and into the 1890's. The vicinity of South Fork was heavily logged for Douglas-fir ties (DuBois 1903) as shown below.

- ▶ "In the late 1800's and early 1900's many people supplemented their farm income by selling ties to the railroad" (White 1987). In the 1880's, cutting of Douglas-fir occurred in the Alamosa River drainage. Thousands of trees were cut along the Rio Grande, from Wagon Wheel Gap to Del Norte, in the 1880's (USDA FS 1936). Ties for the Rio Grande railroad from La Veta Pass to Creede were all cut from Government-owned lands and this was also true of the narrow-gauge line from Alamosa to Durango (RGNF 1949).

- ▶ Methods of cutting ties were sometimes wasteful, with "in some cases only one eight-foot tie being taken from a tree 60 feet long" (DuBois 1903). Portable sawmills were operating to manufacture Douglas-fir lumber from the butt logs left from tie hacking (DuBois 1903). Logging around Summitville, Jasper, Platoro, and Elwood Pass supplied lumber for mines. An area of a one and a half sections, from 11,000' to timberline, near Summitville was "cut practically clean" in the 1880's. Little or no regrowth occurred, even after 20 years (DuBois 1903).

Before the formation of the RGNF, "lumber operators cut what they wanted and how they wished without any interference or regulation. They made no attempt to acquire title to timber lands, they simply moved their sawmill into the selected area and started to cut. In many instances, only the clear logs were taken out and anything with limbs was not skidded or sawed, in other words they not only high-graded the stand but also high-graded the logs" (RGNF 1949). The excessive cutting resulted in logging practically all of the virgin stands of ponderosa pine, Douglas-fir, and in the north end of the valley, lodgepole pine, which were accessible to the Valley (RGNF 1949).

Beginning around 1880, families of the SLV, used increasing amounts of wood products. They generally harvested dead pinyon, ponderosa pine, aspen, and bristlecone pine. Firewood was one of their main uses of the wood. (Reddin 1990).

1908 to 1950

The RGNF was established in 1908, beginning a period of Federal influence on the land.

Description of the Wagon Wheel Gap area by Bates (1928)

The following information presented by Bates (1928) describes the vegetation at the Wagon Wheel Gap Watershed Experiment project, which was undertaken from 1911 to 1926.

- ▶ The forest, within the experiment-area boundary, at an elevation of 9,000' - 10,600', was described as "light and open and typical of the middle zone of the central Rocky Mountains characterized by Douglas-fir as the permanent tree type." An 1885 forest fire made most of the cover a temporary and immature type. Douglas-fir and bristlecone pine on southern slopes escaped the main fire, although they were probably thinned. Complete destruction of Douglas-fir and Engelmann spruce occurred on northern exposures and at the head of the watersheds.
- ▶ Aspen stands varied greatly in size and density of stocking. On some south-facing slopes, the aspen had not grown to more than 10' and were 2"-3" in diameter. On more northerly aspects, tree height reached 30"-40" feet with 6"-7" diameters. Some were densely crowded. "Good stands of aspen were confined to the banks of the streams and to wet ground near springs."
- ▶ Douglas-fir on south exposures were short and stocky with heights under 40' and diameters up to 20". "At best crowns did not occupy one-third of the available space." North-slope Douglas-fir were taller, straighter, and denser. Maximum height was 70'.

- ▶ A few patches of Engelmann spruce remained scattered among the aspen. Fire-killed trees on flatter ground at the head of the watershed were up to 100' in height and 30" in diameter. "Small seedlings of Douglas-fir and spruce were found to be numerous under most of the aspen."

Other Vegetative Information

During the 1930's a geological study of the Bonanza area stated that "most of the slopes in the northern portion of the Bonanza district are heavily wooded with spruce, fir, and pine, and the growths on the north slopes are particularly heavy" (Burbank 1932).

Historic Use of Forest Products

From 1905 to 1916 most timber operators were cutting in the Engelmann spruce area of the RGNF (RGNF 1936). Timber was being harvested on a large scale in 1936 (RGNF 1936). Early families in the Hooper and Mosca area continued to use relatively large amounts of wood, mostly from the Sangre de Cristo Mountains, until the 1940's. Pinyon was, by the 1930's, becoming difficult to find at the more accessible locations (Reddin 1990).

Reforestation began in 1909 in old burns and open parks, all seeding experiments were failures. Limited planting was done from 1912 to 1936, with varying degrees of success (RGNF 1936).

1950 to 1994

Present Composition of Forested Lands

Large wildfires contributed to the current acreage of aspen, now approximately 23% of the RGNF's forested lands. Roughly 83% of the aspen stands are older than 66 years, but none are older than 160. Many of the aspen stands are converting to conifer species such as Engelmann spruce and Douglas-fir.

Lodgepole pine is at the southern periphery of its natural range. It composes 3% of the forested lands on the RGNF. The stand structure of lodgepole pine consists of older, pole-sized, dense stands with little understory growth; however, it can also be found in other forest types. Approximately 92% of the lodgepole pine stands on the RGNF are over 96 years old.

Ponderosa pine currently comprises 3% of the forested lands. Douglas-fir stands occupy about 17%, and Engelmann spruce and subalpine fir comprise 48%.

Use of Forest Products

For the past 45 years, the annual volume of timber sold from the RGNF, predominantly Engelmann spruce and subalpine fir, has averaged 19.7 MMBF

- ▶ Since 1948, the volume rose steadily from approximately 5 MMBF to approximately 22 MMBF by 1955
- ▶ By 1963, harvest levels had declined to approximately 10 MMBF, before rising sharply to 30 MMBF in 1965
- ▶ Harvest levels varied from 31 MMBF to 15 MMBF between 1965 and 1985
- ▶ The volume of live timber sold annually during the 10 years from 1985 to 1994 ranged from 24.9 MMBF to 32.9 MMBF. Dead timber volume has averaged 1 MMBF per year. In addition, a few hundred thousand board feet of aspen sawtimber have been clearcut each year.

Timber Harvest Methods

Logging methods early in this period tended to be even-aged, with large acreages of clearcuts and shelterwood cuts. Large clearcuts, and sometimes, post-harvesting practices of hot, post-sale fuel-reduction burns, created sites that were slow to regenerate. In 1985, the dominant silvicultural prescription applied in meeting the Forest Plan was the shelterwood system. This regeneration cutting has left stands more open than uncut stands and is usually done in three stages over 40 years. Most of the volume has been the result of carrying out the first of the three cutting steps, called the "preparatory" cut. There have been several second-step entries also.

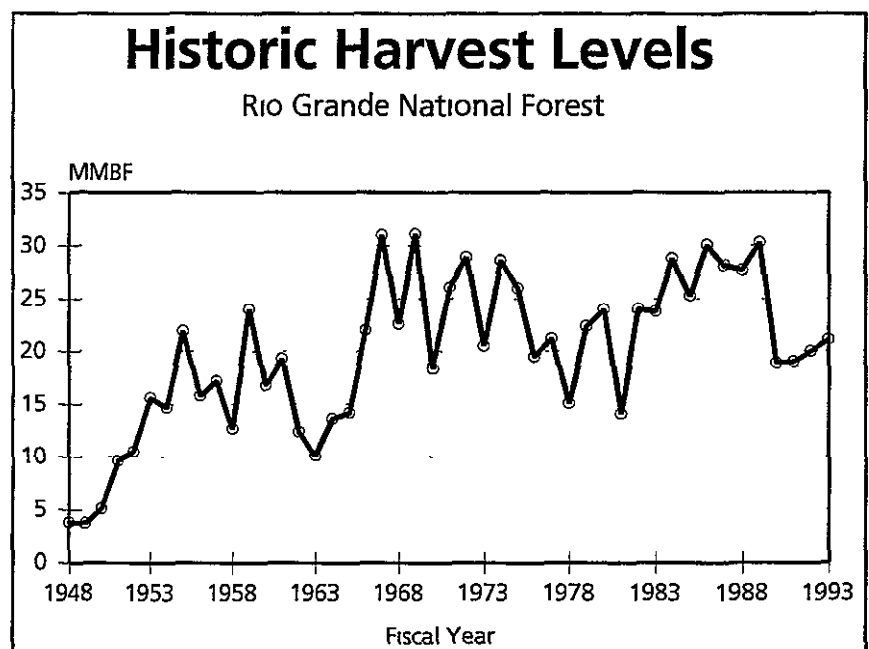


Figure A-5 Historic Harvest Levels

More recently, the trend has been to log spruce-fir with uneven-aged systems, both individual-tree and group-selection methods, leaving continuous canopies of spruce-fir, except for small patches 1/4 to 2 acres in size. Clearcutting in spruce/fir stands is generally limited to 2- to 5-acre openings, called patch cuts. Patch cuts occur in areas that have a

water-production emphasis or, occasionally, for wildlife habitat improvement. Approximately 170,000 acres of the RGNF have been subjected to some form of tree harvesting

Summary and Conclusions: Forested Communities

Ecosystem parameters evaluated were species composition, distribution, and stand structure. The period focused on is 1875 to the present, though general conclusions are discussed which relate to long-term climate.

Historical documentation specifically detailing the ecosystem parameters is incomplete and inconsistent, and often appears biased by the few observers who made the effort to record some aspect of ecosystem parameters. In addition, much of the information gathered came from a narrow geographic area or perspective, which does not lend itself to general conclusions. Observations do not detail general forest conditions or provide statistically reliable data that is now accepted by peer-reviewed scientific study.

Long-term climatic changes have influenced the composition, distribution, and structure of present forest communities. Pollen studies reveal five periods of significant tree-line migration during the last 10,000 years. Climatic records show changing periods of moist/cool and dry/warm which have undoubtedly affected ecosystem parameters, though to what extent is unknown.

Historical records make note of large areas of the Forest burned by sheep herders, ranchers, miners, and railroad crews. Records also show that the RGNF was established in part to control forest fires.

- ▶ Taken together with known periods of drought, fire-adapted ponderosa pine (and to a lesser degree, Douglas-fir) stands were more open, contained more large-diameter/thick-barked individual trees that could withstand repeated fires, and contained fewer small-diameter stems. The stands also contained seral or climax species such as Douglas-fir and white fir.
- ▶ Conversely, we assume there is a greater predominance of small-diameter and/or thin-barked late-seral trees in ponderosa pine and mixed-conifer stands today. This has had further effects upon insects and disease incidence in these stands.
- ▶ The effect of repeated fires on aspen communities is alluded to in historical information -- that is, that large acreages of aspen in various stages of development were present in the early to mid-1900's. We suspect that aspen-dominated stands were probably at historically high levels at this time, but there are insufficient records to verify this.

Historical records point to certain periods when specific wood products were intensively used (e.g., fuelwood during initial settlement, cutting of Douglas-fir during railroad construction, heavy logging of selected spruce stands in the early 1900's).

- ▶ Intensive selective cutting of certain species and size classes (i.e., harvesting large versus small trees) could have influenced the composition and structure of

mixed-species stands or stands exhibiting variable size classes. Heavy cutting of Douglas-fir for railroad ties would favor other species in the Douglas-fir/mixed-conifer stands. Similarly, heavy logging of Engelmann spruce might favor subalpine fir.

- ▶ Both scenarios could have caused compositional and structural changes in these forested stands, if the less used species were not too damaged during the logging operations and conditions were conducive to their growth. Whether such conditions existed after logging occurred is unknown, so definitive conclusions cannot be drawn.
- ▶ Recent cutting (since 1950) has averaged 19.7 MMBF per year. Whether the removal of woody material on this scale duplicates the removal of woody debris by natural processes (fire, insects, disease) is unknown.

IX. NONFORESTED COMMUNITIES

13,000 B.C. to 1600 A.D.

Historic Use of Nonforested Communities

People of the Paleo-Indian period used a variety of plants to supplement their diet of large game (Guthrie et al. 1984). Expanding populations and the extinction of the Bison (*Bison antiquus*) led to an increase in plant usage during the Archaic Period. However, the effects of prehistoric plant-gathering activities on nonforested communities were probably limited because of low populations and the seasonal nature of their habitation.

The plant species most likely used by the above cultures include *Artemisia* (sagebrush), Cactaceae (cactus), *Amaranthus*, *Chenopodium* (goosefoot), *Cleome* (beeweed), Cruciferae (mustard family), *Eriogonum* (buckwheat), Gramineae (grass seeds), *Juniperus* (juniper), *Opuntia* (pricklypear), *Pinus edulis* (pinyon), *Portulaca* (purslane), *Prunus* (chokecherry), *Quercus* (oak), *Rumex* (dock), *Sphaeralcea* (globe mallow), *Umbelliferae* (carrot family), and *Yucca* (Scott 1987). In addition, stinging nettle, marsh marigold, plantain, milkweed, fireweed, lambs quarter, mountain sorrel, willow, evening primrose, mariposa lily, stone crop, violet, kinnickinick, rose, puccoon, paint brush, and raspberry were also used to some degree (Getz N.D.). Plant seeds were often spread to other locations as American Indians moved from place to place.

1600 to 1875

Historic References to Nonforested Condition

Some general statements concerning the condition of nonforested areas were made by visitors to the area.

- ▶ The earliest notation of nonforested communities was that of General Edward Beale, who explored Cochetopa Pass in 1853. Beale said that portions of the area were composed of "luxuriant and nutritious grasses" (Hafen 1957). Later notes by

Beale, in June of 1858, say that "dense stands of clover" covered the creek bottoms and moist slopes near Cochetopa Pass (Agee 1924)

- ▶ Loring Expedition members in 1858 said that "good bunch and gramma [sic] grass" covered the La Garita Mountains (Hafen 1946)
- ▶ In 1873 members of the Ruffner Expedition, between Del Norte and present-day South Fork, stated that the "upland affords good grass" (US Army Corps of Engineers 1873)
- ▶ Wheeler Expedition writings from 1875 state that "bunch grass is found in considerable quantity" in the smaller mountain valleys near the Conejos River. The presence of grama grass is also mentioned in the surrounding pinyon forest (USGS 1878)

History of Grazing

Domestic grazing, which has the potential to influence the condition of nonforested lands, began in the early 1630's when the Utes started pasturing considerable numbers of horses in mountain meadows (Pettit 1982).

The SLV was used for cattle and sheep range since Taos was founded in the late 1700's; by 1820 "over 5,000 head of cattle were taken into the Valle de San Luis to winter" (Oliver 1985). From 1820 to the late 1860's, practically all of the stock were kept in the lower elevations of the SLV in the summer with only a few getting back into the foothills, and "only occasionally were herds taken into the mountains by the most venturesome" (RGNF 1926) By the 1870's there was a "remarkable increase" in both sheep and cattle, (RGNF 1926) which resulted in increased use of foothill and high-country grazing.

Specific examples of early domestic grazing include

- ▶ By 1856 the Montoya brothers began grazing their sheep in the foothills between the Conejos and the Alamosa Rivers, by 1859 the brothers were grazing their sheep in Rock Creek, and in 1860 they were in Raton Park (RGNF 1926)
- ▶ In 1858 the original settlers of the town of La Garita owned both sheep and cattle (White 1987).
- ▶ In 1872, an estimated 5,000 head of cattle were grazed in the northwest portion of the SLV, with the major camp near the forks of Embargo and Baughmann Creeks (RGNF 1934)
- ▶ The high country near Summitville was grazed by sheep owned by Manual Martinez in 1873 (RGNF 1926)
- ▶ Ruffner reported in 1873 that on the foothills from Del Norte to present-day South Fork "cattle run and thrive, unsheltered and unfed, summer and winter" (U S Army Corps of Engineers 1873)

1875 to 1908

History of Grazing

DuBois (1903) said that domestic sheep grazing was perceived as more of a problem than cattle grazing. This was because of overstocking and the practice of bringing the animals onto the range too early. He said that sheep often stayed in an area too long resulting in areas being badly trampled and often eroded. There was also excessive trampling with resultant erosion along routes and trails between parks and the alpine range. Large patches of timberline willow were nibbled nearly to the ground. "The chief evil effect of sheep grazing in the forest is the destruction of the humus and ground cover resulting in a reduction of forage species and an increase in erosion" (DuBois 1903).

Domestic cattle and sheep grazing increased dramatically, as suggested by the following observations

- ▶ Narajano Montoya and his brothers ran sheep in the lower country near Del Norte. In 1883 they took the sheep to the mountains near the head of Beaver Creek and Cross Creek, running more than 10,000 sheep and several hundred cattle (RGNF 1926)
- ▶ The La Garita Stock Driveway, beginning at the bottom of La Garita Canyon and following the divide of the La Garita Mountains to Snow Mesa, then following the Continental Divide to West Ute Creek, was used by sheep herders throughout the SLV. An estimated 100,000 sheep used the stock drive each spring and fall (White 1987). Peak use was probably in the late 1880's and early 1890's
- ▶ Before establishment of the RGNF, the Warshauer Land and Cattle Company grazed 56,000 sheep on the Conejos River during the summer, as far west as Elwood Pass. They said that they had had the whole country to themselves without any regulation until 1905, when the San Juan National Forest was formed (RGNF 1950)
- ▶ The Warshauer Land and Cattle Company also grazed 4,000 head of cattle in La Jara Creek, Jim Creek, Conejos Canyon, and the lower portion of the Cumbres range, and said that several other outfits were running between 15,000 and 20,000 cattle in the lower part of the SLV, on the west side (RGNF 1950)

1908 to 1950

History of Grazing

After the establishment of the RGNF, sheep management focused on moving sheep to allotments using established stock driveways. Herding made the most effective use of the forage, prevented mixing of bands, and also prevented losses to predators.

In 1910 there were 150,000 sheep grazing on the RGNF, and by 1925 the number had grown to 245,000. Numbers of sheep declined steadily from 1925 to 1950, when about 104,000 sheep were grazed. Approximately 17,000 cattle were grazing the RGNF in 1910,

with a rise to about 24,000 by 1920. Between 1920 and 1940 there was a steady decrease in numbers to around 11,000. By 1944 the number rose to around 16,000.

Heavy stocking of cattle and sheep from 1917 to 1921, along with "universal mismanagement of the herds," caused a decline in range condition. Herds were often forced to leave in mid-season (RGNF 1929b). Erosion, due mostly to heavy grazing, resulted in some areas (USDA 1936).

1950 to 1994

History of Grazing

By 1944 the number of cattle grazed on the RGNF was around 16,000. This number remained consistent until 1971, when the number reached around 22,000. From 1971-81 the number of cattle grazed ranged from a low of 17,000 to a high of 24,000. This information indicates that the number of cattle grazing has been relatively consistent.

In 1950 there were approximately 104,000 sheep being grazed. That number declined steadily until 1973, when the number was approximately 30,000. Between 1973 and 1981, the numbers rose from approximately 30,000 to about 48,000.

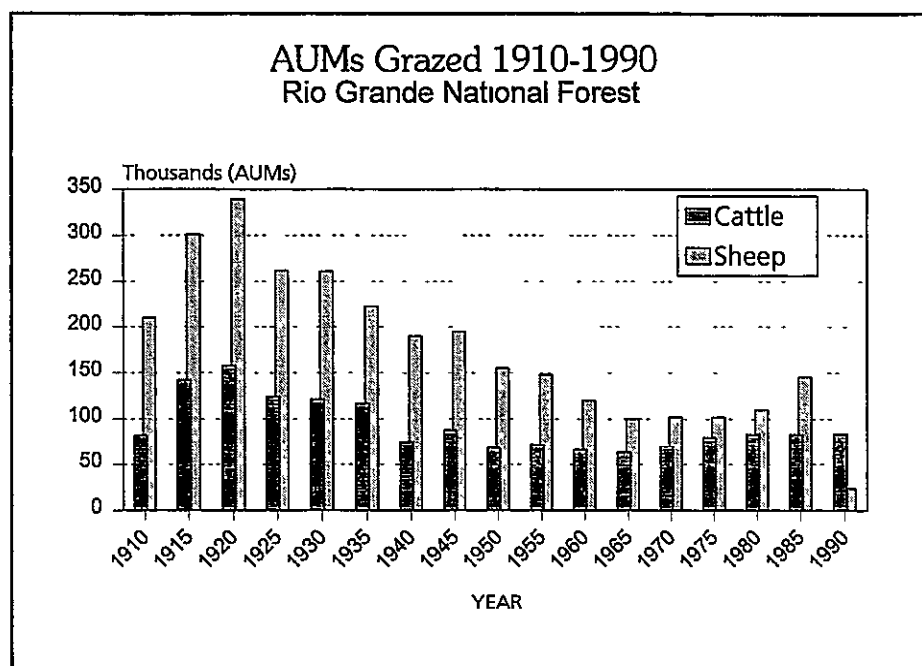


Figure A-6. Livestock Grazing from 1950-1994

Nonforested Communities and Livestock Grazing Influence

Historic livestock grazing probably had a large influence on the composition of nonforested communities on the Forest. As early as 1820, there were records of cattle being brought into the San Luis Valley. By the close of the century, and the early part of the 20th century, there were high numbers of livestock on the RGNF. Specific stocking rates could not be defined since the numbers, land area, and time periods of grazing were not specifically and clearly recorded. It appears that by 1929, stocking rates started declining dramatically due to documented overuse of the resource.

Plant species generally react in predictable outcomes to repeated livestock grazing. As more palatable plants are reduced or eliminated from a community over time, there are other native plants that increase in prominence. There are also introduced plants that have increased significantly under frequent, repeated livestock grazing.

In 1985, of the 581,492 acres of capable and suitable rangelands on the Forest, approximately 50,000 acres (9%) were estimated to be in low ecological condition (USDA Forest Service 1985). The Forest Ecologist believes that much of the nonforested acreage is in mid-seral ecological condition or below. The basis for this assessment is from using diagnostic plant species as indicators of ecological change and the vegetation composition typically seen in these communities across the Forest. However, there is no systematic inventory that documents the composition or condition of the Forest's nonforested lands.

Mid-seral and lower ecological conditions in nonforested communities means that there should be an increase in certain plant species and a decrease in the typical site dominants. The following information gives a general overview of which diagnostic plants usually increase in prominence by vegetation zone and general habitat (separated by riparian and upland ecosystems). The basis for whether a plant species increases in community prominence under ecological deterioration comes from the applicable Soil Conservation Service (SCS) Range Site descriptions developed for this portion of Colorado (USDA Soil Conservation Service 1975-1987). Taxonomic nomenclature follows Dennis and Antonio (1980) for consistency with the SCS Range Site descriptions. Species marked with an "*" are introduced, non-native species. These species show important shifts in the Forest's biological diversity since they did not exist here before settlement.

FOOTHILL ZONE (approximately 8,000 feet and below).

Riparian ecosystems: as ecological condition deterioration occurs, there are generally increases in foxtail barley (*Hordeum jubatum*), rabbitfoot grass (*Polypogon monspeliensis*)*, dandelion (*Taraxacum officinale*)*, Kentucky bluegrass (*Poa pratensis*)*, dock (*Rumex* sp.), rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *consimilis*) on drier fringes, mat muhly (*Muhlenbergia richardsonii*), Baltic rush (*Juncus balticus*), Rocky Mountain Iris (*Iris missouriensis*), herbaceous cinquefoils (*Potentilla* sp.), and Canada thistle (*Cirsium arvense*)*. Nebraska sedge (*Carex nebraskensis*) may remain indefinitely on the water's edge but will become extremely broken and hummocky.

Upland ecosystems: as ecological condition deterioration occurs, there are generally increases in Russian thistle (*Salsola iberica*)*, prickly pear cactus (*Opuntia polyacantha*), Green's rabbitbrush (*Chrysothamnus greenii*), rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *consimilis*), snakeweed (*Xanthocephalum sarothrae*), hairy goldaster (*Heterotheca villosa*), sleepy grass (*Stipa robusta*), cheatgrass (*Bromus tectorum*)*, fringed sage (*Artemisia frigida*), sunflower (*Helianthus* sp.), pinque hymenoxys (*Hymenoxys richardsonii*), lambsquarter (*Chenopodium album*), tansy mustard (*Descurainia pinnata*), pepperweed (*Lepidium montanum*), ring muhly (*Muhlenbergia torreyi*), slimstem muhly (*Muhlenbergia filiculmis*), and three-awn (*Aristida fendleriana*). Pinyon pine (*Pinus edulis*) and juniper (*Juniperus scopulorum*) may increase -- possibly tied to a combination of fire suppression and repeated grazing of fine fuels. Blue grama (*Bouteloua gracilis*) generally increases initially and then eventually becomes patchy with an increase in bare ground.

MONTANE ZONE (approximately 8,000 - 10,000 feet):

Riparian ecosystems: as ecological condition deterioration occurs, there are generally increases in dandelion (Taraxacum officinale)*, timothy (Phleum pratense)*, redtop (Agrotis stolonifera)*, Kentucky bluegrass (Poa pratensis)*, Canada thistle (Cirsium arvense)*, red clover (Trifolium pratense)*, white clover (Trifolium repens)*, Baltic rush (Juncus balticus), Rocky Mountain Iris (Iris missouriensis), yarrow (Achillea millefolium), herbaceous cinquefoils (Potentilla sp.), false hellebore (Veratrum californicum), rose (Rosa woodsii), and shrubby cinquefoil (Potentilla fruticosa). Sedges (Carex sp.) on permanently wet spots retain their position much longer than plants on slightly drier spots because of reluctance of livestock to graze in water.

Upland ecosystems. as ecological condition deterioration occurs, there are generally increases in sleepy grass (Stipa robusta), ring muhly (Muhlenbergia torreyi), three-awn (Aristida fendleriana), fringed sage (Artemisia frigida), scarlet globemallow (Sphaeralcea coccinea), snakeweed (Xanthocephalum sarothrae), pinque hymenoxys (Hymenoxys richardsonii), curleycup gumweed (Grindelia squarrosa), flannel mullein (Verbascum thapsus), cheatgrass (Bromus tectorum), slimstem muhly (Muhlenbergia filiculmis), bluegrama (Bouteloua gracilis), rubber rabbitbrush (Chrysothamnus nauseosus ssp. consimilis), and Howard rabbitbrush (Chrysothamnus parryi ssp. howardii).

SUBALPINE ZONE (approximately 10,000 - 11,800 feet)

Riparian ecosystems as ecological condition deterioration occurs, there are generally increases in those species previously listed for riparian ecosystems in the Montane Zone

Upland ecosystems as ecological condition deterioration occurs, there are generally increases in Parry rabbitbrush (Chrysothamnus parryi ssp. parryi), Douglas knotweed (Polygonum douglasii), tarweed (Madia glomerata)*, herbaceous cinquefoil (Potentilla sp.), yarrow (Achillea millefolium), strawberry (Fragaria sp.), shrubby cinquefoil (Potentilla fruticosa), fringed sage (Artemisia frigida), Kentucky bluegrass (Poa pratensis)*, pussytoes (Antennaria sp.), and fleabane (Erigeron sp.).

ALPINE ZONE (approximately 11,800 feet and above)

Poorly drained soils (water table at 0-3 feet) as ecological condition deterioration occurs, there is a loss of willows (Salix sp.) with an increase in sedges (Carex sp.), alpine bluegrass (Poa alpina), yarrow (Achillea millefolium), sabbaldia (Sibbaldia procumbens), and cushion plants

Well-drained soils as ecological condition deterioration occurs, there are generally increases in mountain avens (Geum rossi), herbaceous cinquefoil (Potentilla sp.), yarrow (Achillea millefolium), sabbaldia (Sibbaldia procumbens), pussytoes (Antennaria sp.), fleabane (Erigeron sp.), cushion plants, clover (Trifolium sp.), and tufted hairgrass (Deschampsia cespitosa)

Additional changes across all vegetation zones:

There have been seedings of introduced grasses, primarily along travel corridors, of smooth brome (Bromus inermis) and timothy (Phleum pratense)

There is evidence that nonforested communities have probably been altered compositionally as a result of repeated, frequent domestic-livestock grazing. There is no evidence that pre-settlement herbivory would have been as high, as frequent, repeated annually, nor cover the majority of the nonforested landscape as the grazing which occurred around the turn of the century. Riparian areas may have been compositionally altered the most if the number and extent of introduced species is an indicator. The upland nonforested communities have probably been altered less, but it is doubtful the extent of acreage in mid-seral and lower ecological condition would have existed prior to settlement. For these reasons, the nonforested communities of the Forest, collectively, are probably outside the RNV.

Summary and Conclusions: Nonforested Communities

Early journals and records give an incomplete description of nonforested communities. There are no records of pre-settlement species composition or landscape pattern. Even today, there are no comprehensive, detailed inventories of species composition and the condition of nonforested communities. Therefore, we can make only general inferences.

One inference is that before settlement by Hispanics and Europeans, the major environmental disturbances in nonforested communities were probably wildfire and wildlife grazing. After settlement, wildfire frequencies may have initially increased over most ecosystems and then gradually decreased with fire suppression in this century -- especially in the lowest elevations. Large native ungulate (hoofed mammals) grazing decreased initially after settlement and then gradually increased in this century. Domestic livestock grazing increased dramatically after settlement and then gradually decreased in this century.

We are assuming the fire frequency in nonforested ecosystems is similar to the fire frequency of adjacent forested ecosystems. If this is true, the fire frequency was probably higher at lower elevations and lower at higher elevations. Fire suppression has been most effective this century in the lower elevations. Consequently, changes in the natural fire regime are probably more significant at the lower elevations on the RGNF and the RGNF is probably experiencing a longer fire frequency interval in lower-elevation ecosystems.

Historic documentation shows livestock grazing was a dominant, new phenomenon that influenced nonforested communities in post-settlement days. Indications are that nonforested communities were probably altered compositionally because of repeated, frequent domestic livestock grazing.

We have no evidence that pre-settlement grazing was as high or as frequent as the domestic grazing around the turn of the century. There is also no evidence that it was repeated annually or covered as much of the nonforested landscape. If the number and extent of introduced species are any indication, riparian areas probably underwent the greatest change compositionally. The upland nonforested communities have probably been altered less, but it is doubtful the extent of acreage in mid-seral and lower ecological condition would have existed prior to settlement. For these reasons, the nonforested

communities of the RGNF, collectively, have probably undergone more alteration (in terms of species composition) since settlement.

Summary and Conclusions: Stream Channel Stability

The information we have about use and condition of nonforested lands allows for some conclusions about stream-channel stability. By comparing climate records, deductions concerning the relative potential for vegetative growth between the present and the pre-settlement period were possible. During cool/wet periods streams aggrade, or deposit sediment, because the increased vegetation captures sediments and builds banks. Streams degrade, or erode banks, during warm/dry periods because of less stabilization by vegetation (Malde 1964, Dunne and Leopold 1978).

Historic photographs of the Conejos River and the Rio Grande, taken in 1875, show lush and extensive riparian communities. This supports the conclusion that if streams supported lush, extensive riparian vegetation in the 1870's, they should be capable of supporting such vegetation in the wetter 1990's, as well.

The 1880's were generally a time of arroyo formation, with stream-cutting resulting from a combination of overgrazing and climatic causes (Malde 1964, Dunne and Leopold 1982). In 1880, lands of the RGNF felt the influence of heavy grazing and fire.

Dubois (1903) documents impacts that heavy livestock grazing and fires had on vegetation in valley bottoms. Bunch grasses were dying out and the range condition was declining from heavy use. Nearly all of the RGNF was subjected to forest fires at least once. Soil erosion was evident in the recent burns and along sheep-herding routes. Precipitation from summer thunderstorms drained quickly from denuded watersheds causing sediment transport, flooding, and eroded channels. Although streams can remain stable during some natural climatic fluctuations, this heavy land use undoubtedly pushed stream degradation outside the natural range of variability.

Another drought period occurred from 1945 to 1975, followed by a cooler, wetter period which has persisted to the present. This suggests the area should be in a period of stream aggradation, accompanied by stream-bank building. Where stream-bank building is not occurring, it may be due to grazing, fires, or other vegetative alterations that prevent the stream from functioning within the natural range.

Mining camps, emerging in the 1880's, had devastating effects on water quality. Some streams were polluted to the point that fish and other aquatic life disappeared. Streams that are still seriously impacted by mine drainage and erosion of tailings include Kerber Creek, Willow Creek, Wightman Fork, and other smaller tributaries that are outside the natural range of variability because of past mining impacts.

X. WILDLIFE

13,000 B.C. to 1600 A.D.

Extinction of Megafauna

During the Late Pleistocene period, the extinction of large animals in North America coincided with the melting of the glaciers (Mehring 1967). In the New World twenty-nine species of large animals went extinct (Jellick 1967) including mammoth, horse, bison, camel, dire wolf, sloth, and mastodon (Hester 1967). *Bison antiquus* is believed to have survived until as late as 5,500 B.C. (Mehring 1967). Their extinction was probably due in part to increased hunting by people during the Clovis and Folsom periods (Jellick 1967).

Prehistoric Hunting Activity

People of the Archaic Stage, from 5,500 B.C. to 500 A.D., hunted both large and small game of the same species found today. The Ute people hunted game such as rabbit, pronghorn, deer, waterfowl, and fish from 1200 to 1881. They also hunted for other forms of life such as lizards and snakes (Guthrie et al 1984).

1600 to 1875

The ID Team found the following references to wildlife

- ▶ Jacob Fowler saw bighorn sheep and 80 or 90 wild horses on the sides of mountains near present-day Del Norte in 1822. Many deer, elk, and bear were also seen near the present site of South Fork. Other animals noted were beaver, geese, Sandhill crane, and an "aughter" (probably an otter) (Coues 1970).
- ▶ General Beale frequently saw pronghorn, deer, and grouse in the Carnero Creek area in 1853 (Agee 1924).
- ▶ An account of the Loring Expedition of 1858 indicates that there was an abundance of pronghorn, deer, bear, grouse, duck, geese, and Sandhill crane at Cochetopa Creek (Hafen 1946).
- ▶ In 1872 there were many deer, pronghorn, ducks, and geese. There were few elk and those found were in the South Fork area (USDA 1934a).
- ▶ More than 1,000 pronghorn were counted in 1875 in Antelope Park, near Creede (Wason 1926).

FISH

Members of the Loring Expedition said that there was an "abundance of speckled trout" in the Rio Grande in September of 1858 (Hafen 1946).

BUFFALO

- ▶ Antoine Leroux, a Taos trader, stated that "thousands of buffalo and antelope were present" in the SLV in 1820 (Oliver 1985) In 1853 General Edward Beale found buffalo skulls in the Cochetopa Pass area (Agee 1924). Members of the Loring Expedition of 1858 noted that there were recent sign of buffalo (Hafen 1946) By 1872 badly decomposed buffalo skulls were found in the South Fork area (USDA 1934a), indicating buffalo were there previously.
- ▶ The buffalo were "practically if not wholly exterminated before the country began to settle up in the 1860's," although the Indians told the old timers that the buffalo died after unusually heavy snows one year (Agee 1924)

BIRDS

H W Henshaw, an ornithologist with the Wheeler Expedition, made a trip into the Valley from May 24 to July 2, 1873. He compiled a bird list in Fort Garland, Mount Baldy, and in an area described as being 90 miles northwest of Fort Garland, up the Rio Grande. The list included:

- ▶ Veery, Catbird, Mountain Bluebird, Ruby Crowned Kinglet, Mountain Chickadee, Black-capped Chickadee, White-breasted Nuthatch, Red-breasted Nuthatch, Pygmy Nuthatch, Brown Creeper, House Wren, Virginia's Warbler, Orange Crowned Warbler, Yellow Warbler, Audobon Warbler, Townsend's Warbler, MacGillivray's Warbler, Wilson's Warbler, Cliff Swallow, Violet-green Swallow, Western Warbler Vireo, Townsends Solitaire, Western Shrike, Western Tanager, House Finch, Red Crossbill, Baird's Sparrow, Savannah Sparrow, Junco, Brewer's Sparrow, Western Song Sparrow, Lincoln's Sparrow, Black-headed Grosbeak, Cowbird, Yellow-headed Blackbird, and Western Meadowlark

Also seen were:

- ▶ Brewer's Blackbird, Clark's Nutcracker, Pinyon Jay, Magpie, Stellars Jay, Scrub Jay, Gray Jay, Western Pewee, Olive-sided Flycatcher, Willow Flycatcher, Cordilleran Flycatcher, Dusky Flycatcher, Hammond's Flycatcher, Belted Kingfisher, Western Nighthawk, Poorwill, Rufous Backed Hummingbird, Broadtailed Hummingbird, Three-toed Woodpecker, Hairy Woodpecker, Downy Woodpecker, Red-naped Woodpecker, Black-breasted Woodpecker, Red Shafted Flicker, Sparrow Hawk, Redtail Hawk, Great Horned Owl, Band-tailed Pigeon, Blue Grouse, and Mountain Plover (Wheeler 1875)

1875 to 1908

Wildlife Numbers

- ▶ Numbers of elk, deer, pronghorn, and mountain sheep decreased near Creede from 1890 to 1895, due to the rush of people associated with the mining boom Pronghorn along the Rio Grande were either killed off or had migrated out of the area by 1881, the herd in Antelope Park dwindled to a single specimen in 1883 (USDA 1936a)

- ▶ Elk, which were numerous near Stony Pass and Pole Mountain in 1882 (Griswold 1988), became very scarce by 1890 (USDA 1936a). Commercial hunting began in 1879 and by 1886 the elk population had been seriously reduced. The Saguache Park area had only 30 elk left by the early 1900's (Agee 1924). By 1907 elk began to increase with small herds being seen, the largest numbered 12 at Wagon Wheel Gap (USDA 1936).
- ▶ Mountain sheep were abundant near Wason Park in 1889 (USDA 1936) and 50 were seen just east of Creede in the same year (Wason 1926). The last mountain sheep in the Cat Creek area was reported to have been killed in 1879 (USFS 1926). By the early 1900's mountain sheep were reduced to near extinction (Agee 1924).
- ▶ Mule deer were abundant until the 1880's, when hunting took its toll (USDA 1936). By 1886 deer were considered too scarce for commercial hunting (Agee 1924).
- ▶ A considerable number of wolverines were trapped by A. C. Rowell at the headwaters of the Rio Grande and in 1903 he saw wolverine tracks there (Warren 1942). Wolverine were shot in Antelope Park and were said to have been not all that uncommon in the 1880's (Cary 1911).
- ▶ By 1907 there were only a small number of grizzly bear left in the San Juan Mountains, although they were said to be quite common as late as 1873 (Cary 1911). Wolf were common in the San Juan Mountains prior to 1911 (Cary 1911). A few lynx were still present in the San Juan Mountains just prior to 1911 (Cary 1911). In 1890 to 1895, wild turkey were seen in the summer in the Red Mountain and Spar City areas, with a small flock also on the Conejos River (USDA 1936).

FISH

Hayden stated in 1873 that the twelve or fifteen streams which flow into the center of the SLV were full of trout (USDI 1873). C. H. Toll (1876) mentions when talking about Wagon Wheel Gap in 1876 that "trout were such as you haven't seen for many a year and wont [sic] till you come to Colorado." In 1883 there were 1000 trout counted in Willow Creek, near Creede. This was not unusual for streams in this area (Wason 1926).

The first fish (native trout, rainbow, and brook trout) were stocked in the Rio Grande and other streams in 1891 (USDA 1936). Native trout were abundant in the Saguache Creek drainage, but commercial fishing and impacts of forest fires lowered the numbers by 1895. Saguache Creek was planted with non-native rainbow trout in 1894 (Agee 1924).

1908 to 1950

Wildlife Numbers

ELK

- ▶ In 1907 an estimated 100 elk remained in the San Juan Mountains, including approximately 12 in the Cochetopa Hills. They were scattered and usually found singly or in groups of twos or threes. One of the largest bands was found near the summit of the San Juans, south of Wagon Wheel Gap.

By 1921, approximately 250 elk wintered near Elk Park, and about 150 were on the Creede Ranger District. Elk were said not to have ventured near ranches until after domestic sheep were put into the Elk Creek area. By 1928, increasing numbers of elk were being observed (USDA 1934b).

MULE DEER

- ▶ Mule deer were declining in numbers in 1920 and by 1923 they were becoming scarce. Limited numbers were found on Embargo Creek and La Garita Creek in 1924 and a marked presence of barren does was noticed. The Conejos herd was increasing slowly by 1930 (USDA 1934a).

ROCKY MOUNTAIN SHEEP

- ▶ Observations from 1919 indicated that they were declining in numbers because of natural causes. It was noted that they did not seek winter range at lower altitudes, but stayed in the high timberline regions where survival was difficult. By 1923 they were increasing on Pole Mountain, near Creede, since the range was reserved for their use. In 1928 little if any increase was reported on the Pyramid District, a part of the former Creede Ranger District (USDA 1934c).

Mountain sheep were found in the La Garita Mountains, with 40 head seen in Wason Park and 100 in the Pole Creek/Lost Trail Creek areas in 1931 (USDA 1936). Many sheep were on Bristol Head in the early days, but in 1936 there were only three rams left there (USDA 1936).

PRONGHORN

By 1939, elimination of pronghorn occurred from hunting. Before 1926, deer, elk, bear, and pronghorn all commingled on the winter range (USDA 1926).

BEAR

Bear (mostly brown and black bear) were on the increase in 1936, and it was suspected there were still several grizzly bear around (USDA 1936).

WOLF

A pack of gray wolves was in the SLV from 1914 until 1926, when the last one was killed (SLV Fair 1949)

MOUNTAIN LION

In March 1935, four mountain lions were caught near Sunnyside, just west of Creede. Also seen were lynx, bobcat, fox, and many coyotes (USDA 1936)

BLUE GROUSE

- ▶ In 1928 Ranger Darley stated that grouse numbers were decreasing because of falcons killing them. In 1930 more grouse were seen than had been since 1925, in the Bear and Sheep Creek areas. Ranger Darley noted that sheep kept in tight groups were destructive to nests due to trampling (USDA 1934c)

PTARMIGAN

- ▶ In 1926 domestic sheep were considered responsible for the biggest loss of ptarmigan because of their trampling of eggs. The absence of sheep in the vicinity of South River Peak was said to have been responsible for noticeable increases in numbers. In 1928, 100 ptarmigan wintered in South Clear Creek for the first time in many years. That same year the birds were a common sight on the Conejos District (USDA 1934c).

FUR BEARERS

In 1936 marten, mink, ermine, and muskrats were found with beaver inhabiting most of the Rio Grande tributaries (USDA 1936).

WILD TURKEY

- ▶ The Conejos wild turkey band numbered 34 in 1929, with only 4 remaining in 1931. In 1932 a lone gobbler was seen at Red Lake and two hens were observed in the Valle Victoria vicinity (USDA 1934c). A small flock of wild turkeys was found in the early 1930's on the Conejos River (USFS 1936).

DUCKS

Ducks hatched their young on the lakes of the upper Rio Grande during the summer and then migrated to the SLV (USDA 1936)

1950 to 1994

According to Colorado Division of Wildlife (CDOW) data, the overall population of deer and elk has remained relatively constant during the past decade. On the northern part of the RGNE, the herds have increased noticeably. The winter range for deer and elk is considered to be in fair condition.

The RGNF and the CDOW have pursued an aggressive bighorn sheep transplant program since the 1950's and most of the areas with suitable habitat now have bighorn populations. Some of the major herds are located near Natural Arch, Trickle Mountain, Conejos Canyon, and Seepage Creek. Also transplanted between 1990 and 1993 were 100 moose on the Creede Ranger District.

The RGNF has 75 lakes and 1,050 miles of stream, which contain trout and/or salmon. There are four species of trout (rainbow, brook, brown, and cutthroat) and one species of salmon (kokanee, a landlocked sockeye salmon). Of these species only the Rio Grande cutthroat is native. Not all cutthroat are native, however, as there were early fish plants of Yellowstone and Snake River cutthroat. Generally speaking, the cutthroat and brook trout are found in higher, smaller streams; brown and rainbow trout in the larger, lower streams. Kokanee are restricted to the larger lakes on the Forest.

Blue grouse, ptarmigan, and waterfowl are scattered throughout the RGNF in their preferred habitats of spruce/fir forest, alpine, and wetlands, respectively.

Neotropical bird migrants appear to have experienced population declines in many areas of the United States. These birds dwell in the United States in the summer and migrate to Central America to spend the winter. Of the known bird species, 51%, or 101 species, can be identified as neotropical migrants. These include common night hawk, Rufous hummingbird, barn swallow, mountain bluebird, and American goldfinch.

Three Threatened or Endangered species are known or suspected to occur on the RGNF: the American peregrine falcon, the bald eagle, and possibly the grizzly bear. There are two known peregrine aeries which have been active the past few years. While bald eagles do not nest on the RGNF, they do spend part of the winter along the Rio Grande and the Conejos River within the RGNF.

The existence of the grizzly bear is problematic. In 1979 a female grizzly was killed near Blue Lake in the South San Juan Wilderness. Subsequent searches have not located any additional grizzlies.

Summary and Conclusions: Wildlife

Current population of ungulates, large carnivores, and fish on the Forest are lower than they were between 1822 and the 1890's, and are quite possibly outside the range of variability. The reasons for this conclusion are:

- ▶ In accounts written prior to the advent of commercial hunting, the numbers of deer, elk, pronghorn, and mountain sheep were described by such terms as "innumerable," "hordes," "very plentiful," and "thousands." Though these are obviously inexact counts, and possibly exaggerated, it is unlikely that people would use the same terms today to describe existing ungulate populations. Thus it would appear that current ungulate populations are below those of the period before commercial hunting and fishing took place in the late 1880's and 1890's. In addition, a large ungulate (buffalo) has been lost from the ecosystem and another large ungulate (moose) has been introduced. Populations of the grizzly bear, wolf, and wolverine have been greatly reduced, if not extirpated, from the RGNF.

- There are thought to have been only three fish native to the waters of the RGNF: the Rio Grande cutthroat trout, Rio Grande suckers, and Rio Grande chubs. Trout were considered abundant in the streams of the RGNF, but today their numbers are greatly reduced. The suckers and chubs are almost gone from the ecosystem. Many exotic species, such as brook trout, brown trout, rainbow trout, and white suckers, have been introduced.

XI. INSECTS AND DISEASE

Several insects and diseases have significantly influenced the structure and composition of forest stands. In the montane zone, the most important forest insects and diseases are the mountain pine beetle, *Dendroctonus ponderosae*; the western spruce budworm, *Choristoneura occidentalis*; western tent caterpillars, *Malacosoma* sp. and the dwarf mistletoes, *Arceuthobium* spp. In the subalpine zone, the most important forest insects and diseases are the spruce beetle, *Dendroctonus ruffipennis*, and root-decay fungi, *Heterobasidion* sp. and *Armillaria* sp.

Montane Zone

Mountain pine beetle: The mountain pine beetle, a native insect, is the most destructive bark beetle in the western United States. On the RGNF, this insect attacks and kills lodgepole pine and ponderosa pine. Adult beetles bore into trees, infect them with a fungus, feed on the inner bark, mate, and lay their eggs. After hatching, larval brood feed on the inner bark. The tree dies as a result of the larvae feeding on the inner bark, combined with the fungus clogging the trees' water-conductive tissues.

While no one knows exactly what triggers the beginning or end of a mountain pine beetle outbreak, forest entomologists have found that the severity of an outbreak is directly dependent on the abundance of beetle-susceptible stands. Severe infestations of mountain pine beetle in ponderosa pine develop almost exclusively in stands which have been undisturbed for many years. While climatic factors such as drought, cool rainy weather during the beetle flight period, drastic changes in annual precipitation, or extremely low winter temperatures are suspected of having effects on the dynamics of bark beetle populations, no conclusive evidence exists that these episodes trigger the beginning or end of beetle outbreaks. Infestations may occur during periods of normal or deficient precipitation (Beal 1943, Blackman 1931). Although a variety of parasites and predators are associated with the mountain pine beetle, their influence on its population dynamics is poorly understood.

The mountain pine beetle is most destructive in stands which are growing under crowded conditions and have average diameters of 6" or larger. Stocking level is the single most important variable in determining a stand's risk of mountain pine beetle infestation. Where stands are of high density (greater than 80 square feet of basal area), tree mortality can be severe, but when trees are free to grow, bark beetle impacts are minimal (Clements 1953; Eaton 1941, Keen 1958; Schmid and Mata 1992; Schmid et al 1994). Trees growing in dense stands compete with each other for light, nutrients, and, especially, available soil moisture. At normal population levels, bark beetles attack and kill weaker trees which may be less able to compete for these resources. Under outbreak conditions, bark beetle

populations expand to the point where they will attack almost all of the trees in a stand, even the most vigorously growing, healthy ones

Mountain pine beetles exist wherever ponderosa pine grows on the RGNF, and scattered tree-killing by this insect may always be found somewhere in the foothills zone. A 1940 report on insect control documents that 3900 acres of ponderosa pine were affected by the mountain pine beetle and that efforts were made to control the infestation (RGNF 1940). No recent outbreaks of this insect have been recorded on the RGNF.

Western spruce budworm: The most prominent defoliating insect on the RGNF is the western spruce budworm. A native species, it is the most widely distributed and destructive defoliator of coniferous forests in western North America. The budworm feeds on foliage of the following tree species (in order of preference) Douglas-fir, white fir, subalpine fir, blue spruce, and Engelmann spruce. Defoliation by this insect can cause extensive tree mortality, top-kill, and growth loss. About 5 million acres are infested annually in the western part of the continent, and about 247 million acres of western forests are considered susceptible (Brookes et al 1987).

Over the last several decades, susceptibility to budworm outbreaks has increased on the RGNF. Early selective-harvesting methods, especially the removal of mature ponderosa pine from mixed conifer stands, along with the effective prevention and control of fires since the early 1900's, has resulted in dense stands developing with a higher percentage of shade-tolerant climax tree species favorable to the budworm.

Swetnam and Lynch (1989) performed a tree-ring reconstruction of the history of western spruce budworm outbreaks on the Colorado Front Range and the Sangre de Cristo Mountains of New Mexico. At least nine outbreaks were identified between 1700 and 1983, their average duration was 12.9 years. The average interval between initial years of successive outbreaks was 34.9 years, and the average maximum and periodic growth reductions caused by the outbreaks were 50% and 21.7%, respectively.

Western spruce budworm populations have been at outbreak levels throughout much of the montane zone on the RGNF since the early 1980's (Raimo 1984a; Raimo 1992). During the last decade, the area of visible defoliation on the RGNF has greatly fluctuated. In 1992, the visible defoliation on the Creede and Del Norte Districts alone was approximately 50,000 acres (Raimo 1992). Defoliation has continued through 1994 (Raimo 1994).

Western tent caterpillar: The western tent caterpillar is the most significant defoliator of deciduous trees on the RGNF. The larvae of this native insect may feed on plants in at least a dozen genera, including oaks, roses, poplars, and birches. Most important, the larvae feed gregariously on the leaves of aspens and construct silken tents within their crowns. Repeated defoliation of aspen by this insect results in branch die-back and tree mortality. When large areas of aspen die as a result of repeated defoliation, the clones fail to regenerate, causing openings or changes in forest type.

Tent caterpillar populations probably reach epidemic proportions for a variety of reasons, including the availability of large, contiguous areas of aspen; favorable climatic conditions for the insect, and changes in host-tree physiology (food quality) which improves insect vigor and fecundity. Conversely, tent caterpillar populations decline because of increased pressure from natural control agents such as parasites, predators, and diseases, unfavorable

climatic conditions, and reduced vigor as a result of a decline in food quality and quantity. The predictability of any of the above factors is difficult, at best.

The first reference to a tent caterpillar outbreak on the RGNF was found in an unpublished history of the RGNF (RGNF 1929a). The report refers to a tent caterpillar infestation along the Conejos River which began in 1914 and spread to 300 to 400 acres by 1929. The same report mentions that 20 years previously [1894] the caterpillars had killed all the aspen in that same locality. A tent caterpillar outbreak which began in 1976, southeast of Pagosa Springs on the San Juan National Forest, spread into Chama Basin on the RGNF by the early 1980's (Raimo 1984b, Raimo 1985). By 1984, the area of severe aspen defoliation occurring on both Forests had increased to 94,000 acres. The tent caterpillar populations began to subside in 1985. No tent caterpillar outbreaks have been reported on the RGNF since 1985.

Dwarf mistletoe: Dwarf mistletoe is the most damaging forest disease on the RGNF. Although losses from dwarf mistletoe are not as visible as those caused by insects, the cumulative impacts on growth and mortality are considerable over the life of the forest. Dwarf mistletoes are parasitic flowering plants which damage their hosts by reducing growth, lowering wood quality, and killing or predisposing them to attack from other pests. Spread of the disease occurs primarily by the explosive expulsion of mistletoe seeds to nearby uninfected trees. Long-distance seed dispersal by birds, rodents, or man is rare and of little management concern.

Dwarf mistletoe is widely distributed on the RGNF. According to surveys of 996 stands on the RGNF made in the 1970's and 1980's, dwarf mistletoe occurs on an estimated 71% of the total acres covered by the inventory. Three species of dwarf mistletoe are found on the Forest: lodgepole pine dwarf mistletoe (*Arceuthobium americanum*), ponderosa pine dwarf mistletoe (*A. vaginatum* ssp. *cryptopodum*), and Douglas-fir dwarf mistletoe (*A. douglasii*). Though occasionally found on other hosts, each of the dwarf mistletoes is largely specific to its host species.

Although little documentation exists with regard to the history of dwarf mistletoe conditions on the RGNF, we know that these parasites have been in North America at least since the Miocene period, or at least 25 million years (Hawksworth 1978). The co-evolution of host and parasite has resulted in a highly specialized relationship in which, until the advent of mankind, the two were essentially in balance. Prior to settlement, fire played a major role in determining the distribution of dwarf mistletoe, by affecting stand composition and sanitizing infested stands. In the absence of fire, the distribution and impacts of dwarf mistletoe have undoubtedly increased. Past management practices, such as the incomplete removal of infested trees in timber sale areas, and the perpetuation of uneven-aged-stand conditions (that promote the spread of dwarf mistletoe from overstory to understory trees), have also accentuated the distribution and impacts of the disease. At present, the magnitude of growth loss and mortality due to mistletoe on the Forest, though considerable, has not been documented. Quantifying the impact of mistletoe is difficult because its effect is subtle, apparent only over a relatively long period and governed by a complex array of factors. Some of these factors include:

- ▶ The age at which host trees become infected. Trees infected relatively late in the rotation experience negligible to no effects, in contrast to trees which are infected early and may never reach a merchantable size.

- ▶ The rate of height growth on the tree versus the ability of the mistletoe to spread within the tree
- ▶ Stand structure, density, species composition, and management activities all affect the ability of mistletoe to infect adjacent trees

Subalpine Zone

Spruce beetle: The tree-killing potential of the spruce beetle has been well documented during the last 100 years. This insect infests all species of spruce in North America. On the RGNF, Engelmann spruce is the principal host. The spruce beetle is a bark beetle and the damage it inflicts on trees is identical to that of the mountain pine beetle. The life cycles of the two insects, however, are significantly different. The spruce beetle completes its life cycle in two years, whereas the mountain pine beetle has one generation per year.

Spruce beetles generally prefer to attack green windthrown or other recently downed spruce. As a result, endemic beetle populations are always present, breeding in scattered fallen trees in the spruce-fir forest type. Outbreaks generally begin after a major forest disturbance (e.g., a large windthrow) creates an abundance of suitable breeding material. Small outbreaks have resulted from human activities which have created breeding sites for the insect in or near stands that were susceptible to infestation. Harvesting practices that have created large-diameter spruce slash or increased a stand's susceptibility to windthrow have been responsible for the initiation of small outbreaks.

Beetle populations rapidly increase in fallen trees and then readily attack standing spruce. Outbreaks may persist until suitable host material is depleted. The susceptibility of a stand to spruce beetle infestation is dependent on its physiographic location, the average diameter of spruce in the stand, and the proportion of spruce in the canopy. In general, spruce stands in well-drained creek bottoms, with average diameters greater than 16 inches, basal areas greater than 150 square feet, and canopies comprising more than 65 percent spruce, are highly susceptible to outbreaks.

The spruce beetle is native to the RGNF and populations of this insect have been present in the area for thousands of years. The last outbreak in standing timber in the Rocky Mountain Region of the Forest Service occurred between 1980 and 1985 on the Del Norte District of the RGNF. The outbreak occurred within a timber sale area that was harvested in the 1960's. A windstorm created scattered windthrow throughout the sale area. Spruce beetle populations built up in the windthrown trees and spread to adjacent spruce stands, resulting in an extensive spruce beetle outbreak.

Root diseases (*Armillaria* sp. and *Heterobasidion annosum*): Root disease fungi impact trees in a number of ways. Loss of structural support as roots become decayed often leads to the death of host trees by windthrow. Mortality also occurs directly from girdling of the roots. In addition, root disease infection may also stress host trees to the point where they become susceptible to mortality by other agents, such as bark beetles or drought.

As with dwarf mistletoes, the root disease fungi co-evolved with their hosts. Until the coming of man, the two were in equilibrium. Disease centers would expand, then break up as they became filled with immune or tolerant species. Later, as the fungus died out of these areas (reducing, but not eliminating inoculum levels), more susceptible species would

appear, starting the cycle again. Fire control and selective-logging practices often promote the spread of root disease by favoring the regeneration of more susceptible tree species (in particular, true firs and Douglas-fir) and by leaving stumps which become new food sources for the fungi

On the RGNF, the two most frequently encountered root diseases are *Armillaria* root disease, caused by *Armillaria sp.*, and annosus root disease, caused by *Heterobasidion annosum*. In a survey of conifer root diseases on the San Isabel, Rio Grande, San Juan, and Grand Mesa National Forests, James and Goheen (1980) identified *Armillaria* root disease on all commercially important species of conifers and hardwoods, including white fir, subalpine fir, lodgepole pine, ponderosa pine, Douglas-fir, Engelmann spruce, pinyon pine, Rocky Mountain juniper, and aspen. The disease affects trees of all ages, though smaller and less vigorous trees typically succumb more rapidly to the girdling action of the fungus. *Armillaria* is particularly damaging to the true-fir hosts. While damaging in young (up to 25 years old) lodgepole pine hosts, *Armillaria sp.* ceases to be a management concern in older lodgepole pines (Sharon 1988).

Armillaria sp. lives as a saprophyte on dead organic material such as old stumps left from logging. Survival of the fungus in old dead stumps for up to 50 years is not uncommon. From stumps, the fungus can spread to living hosts by root contacts and rhizomorphs, which are red-brown or black cords of fungal mycelium, which typically look like shoestrings. It is from these structures that *Armillaria* gets one of its common names, "shoestring root disease." Rhizomorphs can grow through the soil from the food base to the roots of living trees. Continued spread by root contacts results in the typical patchy distribution of the root disease, often with mortality in the middle of the expanding disease centers.

In an assessment of various surveys of root diseases in the Rocky Mountain Region, *Armillaria* was found to be commonly associated with bark beetle- and woodborer-attacked and -killed trees (Johnson 1984). Noted in association with *Armillaria* were *Dendroctonus ponderosae*, *D. valens*, *Dryocetes confusus*, *Ips spp.*, *Scolytis ventralis*, Buprestidae and Cerambycidae.

On the RGNF Annosus root disease is most prevalent on white and subalpine fir. While detailed information regarding the incidence and impacts of annosus root disease on the Forest is lacking, a roadside survey by James and Gillman (1979) identified annosus root disease on white fir in several locations on the Conejos Peak and Saguache Ranger Districts. In an additional roadside survey of true-fir mortality centers in southern Colorado (San Juan, San Isabel, Rio Grande, and Grand Mesa National Forests), James and Goheen (1980) found that 59% of symptomatic white fir and 3% of symptomatic subalpine fir were infected by *H. annosum*.

Heterobasidion annosum causes a white, stringy root and butt decay of trees of all age classes. As with *Armillaria* root disease, mortality occurs in groups due to root-to-root spread of the disease. In addition, aerial spread of the disease is accomplished by airborne spores which infect surfaces of freshly cut stumps and wounds. The spore-producing structures of the fungus are found within infected stumps and dead trees, or at the base of infected trees under the litter layer. The fungus has been found in uncut stands where natural wounds may have provided infection courts; however, mortality is more extensive in stands that have been partially cut.

Observations of the fungus in pines in California indicate that annosus root disease centers may be active for at least 30-40 years. Similar information regarding the persistence of the fungus in true-fir stumps and root systems in the Rocky Mountain Region is lacking. However, the fungus does have the ability to act as a saprophyte in dead root systems and persists until the wood is completely decayed.

Heterobasidion annosum is often found with other decay in white fir, including *Armillaria* sp and *Echinodontium tinctorium*. The fir engraver, *Scolytus ventralis*, is also associated with *H. annosum*-infected trees.

Summary and Conclusions: Insects and Disease

The roles of forest insects and diseases are as important as the role of fire in changing the composition and structure of forest ecosystems. Fire's effects on forest ecosystems are usually more acute and more visible than the effects of forest insects and diseases. Forest insects and diseases, however, are ubiquitous and their effects on forest ecosystems are more insidious than are those of fire.

Montane Zone

Mountain pine beetle: The suppression of wildfires over the last 100 years has had an immense influence on the density and age distribution of ponderosa pine stands. With fewer fires to thin stands and create openings where regeneration could become established, ponderosa pine will tend to grow in dense, even-aged, mature stands with few young trees. Stands with these features are susceptible to infestations of mountain pine beetle.

Western spruce budworm: The large areas of multi-aged stands of shade-tolerant species that have been created by selective harvesting and the exclusion of fire from mixed conifer stands have also resulted in large portions of the RGNF being susceptible to infestation by the western spruce budworm. While budworm outbreaks have always occurred in the forests of southern Colorado, tree-ring analyses indicate that outbreaks since the early part of the twentieth century have been more extensive and more damaging than in previous decades.

Western tent caterpillar: The number and size of tent caterpillar outbreaks depends on the number and size of contiguous areas of mature aspen. Prior to settlement, aspen occupied 30% of the forested lands on the RGNF. Today, aspen occupies approximately 23% of the forested lands. Therefore, tent caterpillar outbreaks today may be smaller and less numerous than those that occurred prior to settlement.

Dwarf Mistletoes: The most important effect of dwarf mistletoe is volume reduction, when trees are heavily infested, dwarf mistletoes reduce both height and diameter growth and increase mortality. The extent of loss depends on several factors, including host and mistletoe species, intensity of infection, site index, and stand density and structure. Infestation levels vary greatly from stand to stand depending primarily on the fire history of the stand and past management practices. Significant reduction in yields of stands occurs if they are infected early in their development and if no suppression measures are taken to reduce the spread and intensity of the disease.

Subalpine Zone

Spruce beetle: Although human activities have been responsible for the initiation of some small spruce beetle outbreaks, the vast majority of large outbreaks have been initiated by natural disturbances, such as windthrow that created an abundance of breeding habitat for this insect over large areas. Given the long pre-settlement fire interval in the spruce-fir type, it is unlikely that fire suppression during this century has had an effect on the susceptibility of spruce stands to spruce beetle infestation. Therefore, the number of spruce beetle outbreaks during pre-settlement times is probably not significantly different from the amount of these outbreaks after settlement.

Root diseases (*Armillaria* sp. and *Heterobasidion annosum*): As with the dwarf mistletoes, fire suppression and silvicultural practices that have ignored the root disease fungi have allowed the equilibrium between host trees and root disease pathogens to shift in favor of the pathogens. The result has been a slow but steady increase in the negative impacts of root disease on the RGNF, particularly in the spruce/fir and mixed-conifer cover types.

XII. LIST OF CONCLUSIONS

Fire

- 1) Climatic factors can be correlated with major fire events with more certainty than can human- influence factors, particularly in the spruce/fir cover type.
- 2) The fire regime of the predominant cover type (Engelmann spruce/subalpine fir) was altered by humans during initial settlement, but more on the temporal rather than the spatial scale.
- 3) Lower-elevation mixed-conifer and ponderosa pine sites have been affected by suppression of natural fires, which allowed shade-tolerant species to supplant naturally occurring fire-resistant species and also created unnatural fuel buildup.
- 4) The Engelmann spruce/subalpine fir cover type exhibits some of the most variable and slow successional trends; many 100-150-year-old burns are not showing conifer or aspen reestablishment and still maintain a grass or shrub cover
- 5) In the lower-elevation sites, interruption of the natural fire regime by fire suppression had a more immediate impact on site composition than in upper-elevation sites.

Forested Communities

- 1) Historical records give an incomplete, and sometimes biased, description of forested communities' distribution, composition, and structure
- 2) Long-term climatic changes have directly influenced the distribution, composition, and structure of forested communities.
- 3) Short-term human influences, primarily fire suppression and wood product removal, have directly influenced the composition and structure of forested communities
- 4) Fire suppression has had the greatest influence on lower-elevation forest communities

Stream-Channel Stability Conclusions

- 1) Historic photos document lush, extensive riparian vegetation occurred in the 1870's.
- 2) Climatic records suggest a drought during the 1870's. Presently, there is a wetter climate than in the 1870's
- 3) If streams supported vigorous and extensive riparian vegetation in the 1870's, they should be more capable of doing the same in the 1990's, a wetter period

- 4) Heavy livestock grazing in valley bottoms caused bunch grasses to die out.
- 5) Human-caused fires burned most of the Rio Grande drainage at least once. Fires and heavy sheep grazing denuded large portions of watersheds, causing siltation, flooding, and channel erosion. These effects almost certainly pushed conditions outside the natural range of variability.
- 6) Streams that remain unstable may not have fully recovered from past land-management abuses.
- 7) Early mining had devastating effects on water quality. Streams still seriously impacted by mine drainage and erosion of tailings include Kerber Creek, Willow Creek, and Wightman Fork of Alamosa Creek. The conclusion that these streams are outside the natural range of variability comes from an observed lack of aquatic life and elevated pollution levels.

Nonforested Communities

- 1) Early journals and records give a very incomplete description of nonforested ecosystems' composition, structure, and function.
- 2) The fire frequency was probably higher at lower elevations and lower at higher elevations, based upon suspected fire frequencies in forested ecosystems.
- 3) Fire suppression has been most effective this century in the lower elevations. Consequently, changes in the natural fire regime are probably more significant at the lower elevations on the Forest. The Forest is probably experiencing a longer fire-frequency interval in lower-elevation ecosystems, but not in higher-elevation ecosystems.
- 4) Livestock grazing is a dominant, new phenomenon influencing nonforested communities post-settlement.
- 5) There is general evidence that nonforested communities have probably been altered (in their species composition) because of repeated, frequent domestic livestock grazing. This evidence is an inference from the estimated overall ecological condition of the nonforested communities. This was determined by using diagnostic plant species as indicators of ecological change and the vegetation composition typically seen in these communities across the Forest.
- 6) We have no evidence that pre-settlement grazing was as high or as frequent as domestic livestock grazing around the turn of the century. There is also no evidence that it was repeated annually or covered as much of the nonforested landscape.
- 7) If the number and extent of introduced species is any indication, riparian areas probably underwent the greatest change compositionally. Less alteration has probably occurred in the upland nonforested communities, but it is doubtful the extent of acreage in mid-seral and lower ecological condition existed prior to settlement.

- 8) The nonforested communities of the Forest, collectively, have probably been altered (in their species composition) since settlement more than they were over the several centuries before settlement

Wildlife

- 1) The population of ungulates is much lower today than historic literature indicates it was in the 1800's
- 2) The large carnivores have been greatly reduced
- 3) The native fish have been greatly reduced.

Insects and Disease

- 1) Ponderosa pine stands have become susceptible to infestations of mountain pine beetle
- 2) Large portions of the RGNF have become more susceptible to infestation by the western spruce budworm
- 3) Tent caterpillar outbreaks today may be smaller and less numerous than outbreaks that occurred prior to settlement
- 4) The number of spruce beetle outbreaks during pre-settlement times is probably not significantly different from the amount of spruce beetle outbreaks after settlement.
- 5) There has been a slow but steady increase in the negative impacts of root disease on the RGNF, particularly in the spruce/fir and mixed-conifer cover types.

XIII. SYNTHESIS AND IMPLICATIONS

Fire

Since limited information exists about fire history in the pre-settlement era and the Native American influence, only broad generalizations and inferences can be made. An intense fire-history study, using tree-ring and fire-scar analysis, would be required before any concrete implications or conclusions could be made.

Settlement and development era information is only slightly better. Inferences were drawn from general field observations, correlated with historic documents and current studies on fire effects and successional stages. The implication drawn from fire suppression in the lower-elevation sites has the most potential significance.

Forested Communities

There are inherent limitations in using the available literature that describe forested communities from a historical perspective. Very few conclusions can be drawn from this incomplete information for two reasons.

- 1) Information collected was not done using scientific methods.
- 2) The bulk of this information was not reviewed by respected members of the scientific community at the time of documentation.

Long-term climatic changes have effectively shaped and molded forest vegetation. The most recent climatic changes (since the last Ice Age) have influenced the ecosystem parameters -- composition, distribution, and structure -- that we are presently attempting to define and evaluate. This conclusion does not help us in identifying ecosystem parameters for forest communities in the period immediately prior to settlement of the RNV.

There is no substantive body of evidence to back up changes in composition and structure due to fire suppression. Because this data is lacking, no conclusions can be drawn about whether we are outside the RNV for forested communities due to effects from fire suppression.

The inference that fire suppression has had the greatest influence on lower-elevation forest communities is drawn largely from both historical written and photographic records, and from similar effects witnessed in like forested communities throughout western North America. It is suspected that we are outside the RNV for structure and composition of low-elevation forested communities -- but again, to what degree is unknown.

Stream-Channel Stability

Except for those streams most drastically altered by past mining activity, no adequate data exists to say that any particular stream is within or not within the natural range of variability. It can be said that, without other influences, streams should be capable of supporting vegetation that will allow recovery from past disturbances. Where this is not

happening, current land uses should be examined to see if they are preventing a stream from recovering to an acceptable condition.

Nonforested Communities

Only broad inferences can be made from the general information available on nonforested communities. Because of this, implications cannot be concisely stated and they must be weighed against the strength of the information. Our definition of a significant implication is one in which an ecosystem parameter has a direct impact on ecosystem sustainability (a sustainable ecosystem is one that maintains its species diversity, productivity, and natural processes).

If fire frequency has been lengthened at lower elevations, there could be implications tied to nutrient recycling, since biomass would not be burning as often. There is no way to know if these changes are significant. Also, there is not enough information to know if a specific nonforested plant community is more at risk than another. There may also be a species-composition change related to lengthening the fire frequency. Again, the consequences are unknown, so we cannot say whether this is a significant implication.

Current nonforested community composition may represent unique conditions on the landscape. This assumes that livestock grazing has created significant species composition changes from pre-settlement conditions. However, there is not enough information to evaluate the resiliency of nonforested ecosystems to know if this is a significant implication.

Wildlife

There are three primary reasons for the changes described. Quite possibly the main reason was the impact of commercial hunting and fishing. This led to precipitous declines in the populations of many species. Although populations have rebounded, they have never recovered fully. Ironically, it was the development and enforcement of sport-harvest regulations which played a big part in the recovery.

It is doubtful that populations can ever reach their former numbers because of habitat changes from human settlement. Some examples are towns built in areas that were once big-game winter ranges, altered stream flows and changes in riparian condition due to water diversions, and more interactions between humans and wildlife as a result of increased driving and hiking.

Second, the large carnivores, such as grizzly bear and wolf, were deemed undesirable and systematically hunted to reduce numbers. Unlike deer and elk, their numbers were never allowed to rebound. While the habitat is present to support some of the carnivores, it is questionable whether they would be socially accepted today.

Finally, fisheries were forever altered by the introduction of exotic species. Here, too, human desires dictate that the native fish will never be allowed to reach their former numbers, since that would necessitate removing the exotic fish which provide a tremendous amount of recreation and money to Colorado. The implications of these changes are impossible to define given our lack of knowledge about the functioning of particular ecosystems.

Insects and Disease

If the current level of fire prevention is continued, and the average density and age of ponderosa pine stands are allowed to increase, larger areas of pine will become more susceptible to mountain pine beetle infestation. Also, outbreaks of this insect will be larger and more numerous than those which occurred prior to the 20th century. Unless the trend toward larger areas of multi-aged stands of shade-tolerant tree species is halted or reversed, the size and severity of western spruce budworm outbreaks will continue to increase. Increased deadfall from these outbreaks will lead to increased severity and intensity of wildfires, making fires more difficult to control. Fires within outbreak areas may have a greater tendency to be stand-replacing fires than those occurring outside budworm-outbreak areas.

If aggressive fire-suppression activities continue on the RGNF, negative effects on tree growth and forest productivity will continue to increase at a slow, steady rate. Similar results will occur if silvicultural practices do not take dwarf mistletoe infestations into account. Not only will the disease cause losses in timber, but recreation will be adversely affected as well, as the disease kills trees in campgrounds, picnic areas, etc. In addition, decay and canker fungi associated with dwarf mistletoe infections may kill or weaken branches, making them more susceptible to wind breakage, thus increasing the hazard to recreationists.

If future human activities create large areas of spruce-beetle breeding habitat or increase the size and number of spruce-beetle-susceptible forests, spruce beetle outbreaks may occur more frequently than in pre-settlement times.

Unless fire-suppression and silviculture practices are changed, the negative impacts of root diseases in the spruce/fir and mixed-conifer cover types will continue. If the frequency of stand-replacing disturbances such as fire or harvest is increased in seral aspen stands, then larger and more numerous tent caterpillar outbreaks can be expected in the future.

XIV. BIBLIOGRAPHY

- Agee, Fred B and J M. Cuenin. 1924 History of Cochetopa National Forest. Salida, Colorado.
- Barler, George A 1924. Geography of Colorado John C Winston Company
- Bates C G and A.J. Henry 1928. "Forest and Streamflow Experiment at Wagon Wheel Gap, Colo., Final Report on Completion of the Second Phase of the Experiment." U.S. Department of Agriculture Weather Bureau Monthly Weather Review, Supplement No 30, U.S. Government Printing Office, Washington, 1928.
- Beal, J.A. 1943. "Relation between tree growth and outbreaks of the Black Hills beetle." Journal of Forestry, Vol. 41 359-366
- Blackman, M W. 1931. The Black Hills beetle (Dendroctonus ponderosae Hopk.) N Y. State College, Forestry Tech Publ. 36, 97 p
- Brookes, M.H., J.J Colbert, R.G Mitchell, and R.W. Stark 1987 Western spruce budworm and forest planning. USDA Forest Service , Washington, D.C Technical Bulletin-1696 88 p.
- Brandon, W E 1955. The Men and the Mountain: Fremont's 4th Expedition New York: William Morrow & Company.
- Brubaker, L B. "Vegetation History and Anticipating Future Vegetation Change " In: Agee, J.K and D R Johnson (Eds) Ecosystem Management for Parks and Wilderness, pp 41-61
- Brunswig, Robert H., Jr. 1992. "Paleo-Indian Environments and Paleoclimates in the High Plains and Central Rocky Mountains " Southwestern Lore, Journal of Colorado Archaeology, Vol. 58, No 4, Winter 1992
- Burbank, W S 1932. "Geology and Ore Deposits of the Bonanza Mining District with a section on History and Production" by C W Henderson. U S Geological Survey Professional Paper 169.
- Carrara, P E , W.N Mode, Myer Rubin, and S W Robinson 1984 "Deglaciation and Postglacial Timberline in the San Juan Mountains, Colorado." Quaternary Research 21, pp 42-55, 1984
- Carrara, Paul E , Deborah A. Trimble, and Meyer Rubin 1991 "Holocene Treeline Fluctuations in the Northern San Juan Mountains, Colorado, U S A , as Indicated by Radio-Carbon Dated Conifer Wood " Arctic and Alpine Research, Vol. 23., No 3, pp 233-246
- Cary, Merritt. 1911 "A Biological Survey of Colorado " USDA Bureau of Biological Survey North American Fauna #33.

- Clements, V A 1953 Possible means of reducing mountain pine beetle attacks in young sugar pine USDA Forest Service, California Forest and Range Experiment Station, Res Note 89. 5p.
- Colorado Division of Water Resources N D Rio Grande National Forest History, Water Division 3
- Coues, Elliot Ed. 1970 The Journal of Jacob Fowler. University of Nebraska Press, Lincoln NE
- Crane, M F 1982 Fire ecology of Rocky Mountain Region forest habitat types. Final Report. Contract from USDA Forest Service, Region Two (Purchase Order No. 43-82x9-1884) on file at the Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 268 pp
- Dennis, Ed, and D Antonio 1980. Common Colorado Range Plants USDA Soil Conservation Service. Denver, CO.
- Denver Tribune. 1878 "Military Wagon Road from Alamosa to Pagosa Springs." Denver Daily Tribune, December 10, 1878
- DuBois, Coert 1903 Report on the Proposed San Juan Forest Reserve, Colorado U S. Department of Agriculture Unpublished Manuscript on file at the Rio Grande National Forest, Monte Vista, CO
- Dunne, Thomas and Luna B. Leopold 1978 Water in Environmental Planning. W.H Freeman and Company, 1978
- Dwyer, D. and R Preper 1967 " Fire Effects on Blue Grama-pinyon-Juniper Rangeland in New Mexico " Journal of Range Management, 20:359-362.
- Eaton, C B 1941. "Influence of the mountain pine beetle on the composition of mixed pole stands of ponderosa pine and white fir " Journal of Forestry, Vol 39:710-713
- Eddy, Frank W , Allen E Kane, and Paul R. Nickens 1984. Southwest Colorado Prehistoric Context Archaeological Background and Research Directions Office of Archaeology and Historic Preservation, Denver, 1984.
- Executive Order 1908. Theodore Roosevelt Rio Grande National Forest, July 1, 1908
- Getz, Carol Ann N.D Plants of the San Luis Valley and How They Were Used by Those Who Came Before
- Griswold, P.R 1988 San Luis Valley Historian, Vol XX, Number 4, 1988, San Luis Valley Historical Society
- Guthrie, Mark R Powys Gadd, Renee Johnson, and Joseph J. Lischka 1984 Colorado Mountains Prehistoric Context State Historical Society of Colorado 1984.

- Hafen, LeRoy R., 1946. "Colonel Loring's Expedition Across Colorado in 1858." Colorado Magazine, Vol 23, No 2, pp. 49-76
- Hafen, LeRoy R and Ann W Hafen 1957 "Central Route to the Pacific" by Gwinn Harris Heap with related material on railroad exploration and Indian affairs by Edward F. Beale, Thomas H. Benton, Kit Carson, and Col E A. Hitchcock, and in other documents, 1853-54. Far West and Rockies Series, Volume VII
- Hafen, L R and A W. Hafen 1959. The Diaries of William Henry Jackson Frontier Photographer to California and return, 1866-1867; and with the Hayden Surveys to the Central Rockies, 1873, and to the Utes and Cliff Dwellings, 1874.
- Hafen, L R and A.W Hafen 1960. Fremont's Fourth Expedition A Documentary Account of the Disaster of 1848-49 with Diaries, Letter, and Reports by Participants in the Tragedy. Far West and Rockies Series Volume XI The Arthur H Clark Co. Glendale, CA.
- Hawksworth, F.G 1978 "Intermediate Cuttings in Mistletoe-Infested Lodgepole Pine and Southwestern Ponderosa Pine Stands " In Scharpf, R.F and J.R. Parmeter, Technical Coordinators. Proceedings of the Symposium on Dwarf Mistletoe Control through Forest Management; 1978 April 11-13, Berkeley, Ca. General Technical Report PSW-31. Berkeley, CA. USDA Forest Service. Pacific Southwest Forest and Range Experiment Station 86-92
- Hester, James J. 1967 "The Agency of Man in Animal Extinctions." Pleistocene Extinctions The Search for a Cause Edited by P S. Martin and H.E. Wright, Jr Volume 6, Proceedings of the VII Congress of the International Associations for Quaternary Research. Yale University Press, 1967
- Horn, Jonathon C. 1990 Cultural Resource Inventory of Forest Highway 69 (Forest Route 250) Rio Grande National Forest, Conejos County, CO Alpine Archaeological Consultants, Montrose, CO
- Hurlbett, Robert E N D "Environmental Constraint and Settlement Predictability," Northwestern Colorado Bureau of Land Management Cultural Resource Series, No. 3 Archaeological
- James, R L and L S Gillman 1979 "*Fomes annosus* on white fir in Colorado " USDA Forest Service., Forest Insect and Disease Mgt , State and Private Forestry, Rocky Mtn Region Technical Report R2-17. 9p.
- James, R L and D J Goheen. 1980 Distribution and characteristics of conifer root diseases on the San Isabel, Rio Grande, San Juan, and Grand Mesa National Forests in Colorado. USDA Forest Service, Forest Insect and Disease. Mgt , State and Private Forestry, Rocky Mtn Region Bioogical Evauation. R2-80-4 17p
- Jelinek, Arthur J. 1967 "Man's Role in the Extinction of Pleistocene Faunas." Pleistocene Extinctions The Search for a Cause Edited by P S Martin and H E. Wright, Jr. Volume 6, Proceedings of the VII Congress of the International Associations for Quaternary Research Yale University Press.

- Johnson, D W. 1984 An assessment of root diseases in the Rocky Mountain Region USDA Forest Service, Timber, Forest Pest, and Cooperative Forestry Mgt Technical Report R2-29 20p
- Jones, Hester 1932. "Uses of Wood by the Spanish Colonists in New Mexico" New Mexico Historical Review, Vol VII, No 3, July 1932.
- Kaufmann, M R , R. Graham, D. Boyce, W. Moir, L. Perry, R. Reynolds, R. Bassett, P. Mehlhop, C. Edminster, W. Block, and P. Corn. 1994. An Ecological Basis for Ecosystem Management. USDA Forest Service, General Technical Report RM-246
- Keen, F.P. 1958. "Progress in bark beetle control through silviculture." In: The United States Proceedings. Tenth International Congress of Entomology (Montreal, 1956) 4 171-179
- Kortright, Dr. S E 1945 "Historical Sketch of the Bonanza Mining District." Colorado Magazine, Vol 22, pp. 68-76
- Kindquist, Cathy E , 1987 Stony Pass, The Tumbling and Impetuous Trail. San Juan County Book Company, Silverton, CO 1987
- Mahan, Bill. 1982. "The Hayden Survey in the San Luis Valley, 1873-1876 " The San Luis Valley Historian, Vol XIV, No. 4, Fall 1982, pp 26-39
- Malde, Harold E 1964 "Environment and Man in Arid America." Science Magazine, Vol 145, No 3628, July 1964
- Mangimelli, John A 1982. "Climatic Change in the San Luis Valley" San Luis Valley Historian Vol XIV, No 2 San Luis Valley Historical Society, Inc
- Mehl, Mel S. 1992 "Old-growth Descriptions for the Major Forest Cover Types in the Rocky Mountain Region." In Old-growth Forests in the Southwest and Rocky Mountain Regions Proceedings of a Workshop. M. R. Kaufmann, W. H. Moir, and R. L. Bassett Tech Coord USDA Forest Service General Tech Rep RM-213. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO pp. 106-120.
- Mehls, Steven F and Carrol Joe Carter 1984. Colorado Southern Frontier Historic Context Colorado Historical Society. 1984
- Mehring, Peter J. Jr 1967 "The Environment of Extinction of the Late-Pleistocene Megafauna in the Arid Southwestern United States." In Pleistocene Extinctions The Search for a Cause Edited by P.S. Martin and H.E. Wright, Jr Volume 6, Proceedings of the VII Congress of the International Associations for Quarternary Research. Yale University Press.
- Mutch, Robert W 1991 "Presentation Paper on Continental Fire Regimes " National Advanced Resource Technology Center, Marana AZ.
- Oliver, Martha 1985 Cattle in the Valley San Luis Valley Historian, Vol XVII, No 4, 1985

- Omi, Dr. Phil. 1992. Colorado State University Personal Communication with Dean Erhard 1/8/1992
- Peterson, Kenneth Lee and Janet D. Orcutt. 1987 Dolores Archaeological Supporting Studies: Settlement and Environment. United States Department of the Interior, Bureau of Reclamation, Denver, CO
- Pettit, Jan 1982 Utes - The Mountain People Century Press, Colorado Springs, CO
- Raimo, B.J. 1984a Western spruce budworm in the Rocky Mountain Region. USDA Forest Service, Rocky Mtn. Region. Biological Evaluation Report. R2-84-5. 17 p.
- Raimo, B.J. 1984b. Western tent caterpillar Blanco Basin, 'V' Rock, Chama Basin Areas. 1984 USDA Forest Service, Rocky Mtn. Region. Biological Evaluation Report R2-84-1 7 p
- Raimo, B.J. 1985 Western tent caterpillar Blanco Basin, 'V' Rock, Chama Basin Areas, San Juan and Rio Grande National Forests USDA Forest Service, Rocky Mtn Region. Biological Evaluation Report R2-85-7 9 p.
- Raimo, B.J. 1992 Western spruce budworm Creede and Del Norte Districts, Rio Grande National Forest USDA Forest Service, Rocky Mtn Region Biological Evaluation Report R2-92-4 9 p
- Ramaley, Francis 1942 Vegetation of the San Luis Valley in Southern Colorado University of Colorado Studies, Series D, Vol I, No. 4
- Reddin, Paul. 1980 "Sand, Saws, and the Sangre de Cristos' A History of Wood Hauling in the Hooper and Mosca Communities" San Luis Valley Historian, Vol XII, No 1
- Richmond, Patricia Joy. 1969 An Expedition of Exploration and Survey with Lieut. William L. Marshall, U S Corp of Engineers, 1875.
- Ridgway, Arthur 1939 "The Stoney Pass Road " Colorado Magazine, Vol 16, No 2, 1939. pp. 52-53
- Rio Grande National Forest. 1926 Grazing History on the Rio Grande National Forest Unpublished Manuscript on file at the Rio Grande National Forest, Monte Vista, CO
- Rio Grande National Forest. 1929a. History of the Rio Grande National Forest. Unpublished Manuscript on file at Rio Grande National Forest, Monte Vista, CO.
- Rio Grande National Forest 1929b. A Decade of Range Management on the Rio Grande National Forest 1920-1929
- Rio Grande National Forest 1934. Memorandum to the Forest Supervisor, Historical Data, May 4, 1934
- Rio Grande National Forest 1940. Letter to Forest Supervisor pertaining to insect control dated June 19, 1940 from District Ranger at South Fork.

- Rio Grande National Forest. 1949 Timber, Rio Grande National Forest.
- Rio Grande National Forest 1950 Historical Information Memo for Historical File Monte Vista, CO, January 26, 1950
- Rio Grande National Forest. 1953 Cumulative Silvical Record for the Rio Grande National Forest Including a Graph by J C. Baird (12/2/48) indicating annual precipitation for Sante Fe New Mexico from 1850 to 1950 and Cumbres/Manasa/Hermit/Garnet from 1910 to 1950
- Rio Grande National Forest. 1982 Rio Grande National Forest Test of Site 5SH903 (Test Square-1) Unpublished report by Vince Spero on file at Rio Grande National Forest, Monte Vista, CO.
- Rio Grande National Forest. 1991 Fire History of the Rio Grande National Forest Unpublished report by Vince Spero on file at the Rio Grande National Forest, Monte Vista, CO.
- Romme, Bill 1993. Personal communication. Fort Lewis College Durango, CO
- Rosenberg, Robert G. 1976 A History of South-central Colorado. Prepared Expressly for The Rio Grande National Forest, May 24, 1976
- San Juan National Forest 1984 San Juan National Forest Cultural Resources Assessment October 1984
- Schmid, J.M and S A. Mata. 1992 Stand density and mountain pine beetle-caused tree mortality in ponderosa pine stands. USDA Forest Service, Rocky Mtn. Forest & Range Experiment Station Res Note RM-515. 4 p.
- Schmid, J M., S A Mata and R A Obedzinski. 1994 Hazard rating ponderosa pine stands in the Black Hills for mountain pine beetles In press.
- Schroeder, Albert H 1965 "A Brief History of the Southern Utes " Southwestern Lore, Vol. 30, No 4, March 1965.
- Scott, Linda J. 1987. Dolores Archaeological Program Anasazi Communities of Dolores Grass Mesa Village Book 2 of 2 U S. Dept of the Interior, Bureau of Reclamation, Denver, CO. March 1987.
- Scott, Linda J and Deborah Truell Seward N.D "Appendix A: Pollen and Macrofossil Analysis at 5ML45 in Mineral County, Colorado "
- Sharon, E M. 1988. Incidence of Armillaria root disease in regenerated lodgepole stands in western Colorado USDA Forest Service, Timber, Forest Pest, and Coop Forestry Mgt. Technical Report R2-43 6p
- Stokes, M A. and J H. Dieterich 1980 Proceedings of the Fire History Workshop. USDA Forest Service Gen Tech Rep RM-81 Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO

- Swetnam, T W and A.M. Lynch 1989. A tree-ring reconstruction of western spruce budworm history in the southern Rocky Mountains Forest Science. 35(4):962-986.
- Toll, Charley H 1876 "A Visit to Wagon Wheel Gap as Told in a Letter." Colorado Magazine, Volume 33, No.2.
- United States Army Corps of Engineers 1873 "Report of a Reconnaissance in the Ute Country in the Year 1873" by Lieut. E.H. Ruffner Washington, Govt Printing Office. 1874
- United States Bureau of Reclamation 1973 The San Juan Ecology Project Interim Progress Report, March 1973 Prepared Under Contract by Colorado State University, Fort Collins, CO 1973.
- United States Congress, House of Representatives. 1874. Reconnaissance in the Ute Country. Letter from the Secretary of War, transmitting a report and map of a reconnaissance in the Ute country, made in 1873 by Lieutenant E. H. Ruffner, of the Corps of Engineers. H.R Ex Doc. No. 193, 43rd Congress, 1st session
- United States Department of Agriculture. 1926. Rio Grande National Forest. Letter dated 2/16/1926 by Darley, Forest Ranger
- United States Department of Agriculture. 1934a. Letter dated 5/4/34 by E S. Erickson, Forest Ranger Rio Grande National Forest Historical Data.
- United States Department of Agriculture. 1934b. Forest Service Fish and Game Work Plans and Annual Report for the Rio Grande National Forest to 1934 Inclusive U.S. Government Printing Office
- United States Department of Agriculture. 1935. Early Day Grazing on the Cochetopa National Forest written by Tibo Gallegos, Forest Ranger The Bulletin, Rocky Mountain Region, Vol. 18, No 2
- United States Department of Agriculture 1936a Forest Service Rocky Mountain Region Bulletin Rio Grande National Forest Special Number Vol 19, No 3. March 1936
- United States Department of Agriculture. 1936b Letter to Forest Officers, Rio Grande National Forest
- United States Department of Agriculture, Forest Service 1937. Range Plant Handbook. Dover Publications New York.
- United States Department of Agriculture 1993 Fire Related Considerations & Strategies in Support of Ecosystem Management. January 1993
- United States Department of Agriculture, Soil Conservation Service 1975-1987. Range Site Descriptions Denver, CO.

United States Department of Agriculture, Forest Service 1985 Final Environmental Impact Statement for the Rio Grande National Forest Land and Resource Management Plan Monte Vista, CO

United States Department of the Interior, Geological Survey 1873 First, Second, and Third Annual Reports of the United States Geological Survey of the Territories for the Years 1867, 1868, and 1869, under the Department of the Interior.

United States Geographical Surveys 1878 "Report upon United States Geographical Surveys West of the One Hundredth Meridian." First Lieut. Geo. M. Wheeler, Corps of Engineers, US Army. Vol. VI. Botany by J T Rothrock Washington: Government Printing Office.

Warren, Edward R. 1942. The Mammals of Colorado.

Wason, Henry. 1926. The Indian ie Fish and Game. Creede, CO.

Wheeler, George. 1875. "Explorations and Surveys west of the 100th Meridian." Vol 5 Zool ogy

White, Frank A 1987. "La Garita " San Luis Valley Historian, Vol. XIX, No 2, 1987.

Wright, H A. 1990 "Role of fire in the management of southwestern ecosystems." In Effects of Fire Management of Southwestern Natural Resources Proceedings of the Symposium, Nov 15-17, 1988 Tucson, AZ J S Krammes, Tech Coord USDA Forest Service General Technical Report RM-191. Fort Collins, CO. p 1-5.

Wyley, Ken. 1993 Personal Communication with Jody Smith 11/20/93

Study of Historic Photographs Pertaining to the Range of Natural Variability of the Rio Grande National Forest

The earliest photographs of the Rio Grande National Forest (RGNF) available are from the Hayden Expedition, taken by William Henry Jackson, and from the Wheeler Expedition, taken by T.H. O'Sullivan in 1874. Photographs from the early 1900's until 1920 are also valuable indicators of the Forest's early habitat. In addition, a number of photographs from a 1908 RGNF silvicultural report were reviewed. During the summer and fall of 1990, retakes of the photos in the 1908 report were made. A team of specialists inspected the photo collection and made observations pertaining to changes in vegetative conditions.

RETAKE PHOTO: 1994 ERHARD/METZGER PHOTO POINT.
ORIGINAL PHOTO: 1874 PHOTO WHEELER.

Location

Photos display a panorama of the Conejos River from Section 25, T 35N , R 4 1/2 E., NMPM

Access

Access to the photo points is from FDR 250. The photo points are on the east side of the road, on the ridge side. Photo Point 17 is located in the original position as the 1874 photo.

Team Comments

Photo Point 17. It appears that there is more narrowleaf cottonwood in 1994. There is more conifer in the background in 1994, especially on the lower slopes. There may have been more sandbars in the 1874 photo. In the center of the 1874 photo, it looks as if there was more herbaceous cover intermixed with the willows.

The 1874 photo appears to have more water in the riparian area. The upland grassland in the foreground is similar in the 1874 and 1994 photos. In 1994 the river's main course is more on the east side of the drainage, versus being on the west side in 1874. The upland park in the upper right of the 1874 photo appears the same, although there are more cottonwoods surrounding it in 1994. There seems to be more idle water on the periphery of the Conejos River in 1994 than in 1874. There are also numerous beaver dams in the drainage in 1994.

Willows appear to be more expanded on the bend in the middle of the 1874 photo. Conifer is heavier in the forested island (center of photo) in 1994. Conifer and aspen have filled in off the toe stand (center of photo extending from Pinnacles area) in the 1994 photo. There are numerous snags in the 1874 photo. The extreme right center of the photo shows a short aspen stand which still appears short in 1994.

The area below the rocky section known as "The Pinnacles" has heavier conifer in 1994. The grassland near the road (immediately adjacent to the Conejos River) is dominated by Kentucky bluegrass. As soon as one gains some elevation on the ridge side, the grassland is dominated by Arizona fescue and Parry oatgrass in relatively vigorous condition.

1874



1994



RETAKE PHOTO: **1990 PHOTO POINT 12**
ORIGINAL PHOTO: **1907 PHOTO #76960**

Location

Photo Point 12 is on a gentle northeast-facing slope approximately three-quarters of a mile southeast of Jacobs Hill, on the Conejos Peak Ranger District, in the east 1/2 of Section 36, T.36N., R.6E., NMPM

Access

Access is from FDR 252 at the Forest boundary. From the Forest boundary go 0.4 mile to the northwest on a lightly tracked road.

Description

This photo point is approximate, but probably within 1,000 feet of the original photo point of 1907. The photographs feature an open pinyon-juniper timber type. Little change appears to have occurred. Some of the juniper that had their main stems removed, probably for posts, are still present and alive. The stand is still open, but appears to have a few ponderosa pine filling in between the pinyon pine trees. Soil erosion is still occurring. Grass and forbs between trees are sparse.

Team Comments

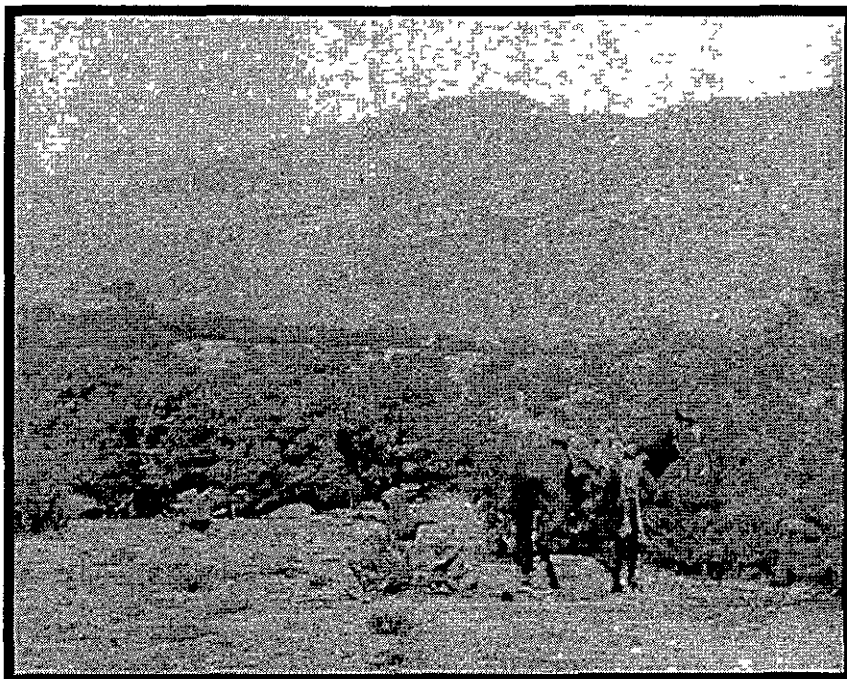
Trees have been removed for posts. The area is also an historical stock driveway, therefore soil deflation is probably due to grazing and/or stock driveway activities.

The background of the photograph (on the south-facing slope) indicates a marked increase in density/cover of pinyon pine and juniper. A wet season/period may have contributed to the increase in pinyon pine and juniper. The increase may also have been due to fire-suppression activities in this century. A combination of livestock removing fine fuels annually and fire suppression may have significantly altered the composition of these pinyon/juniper woodlands.

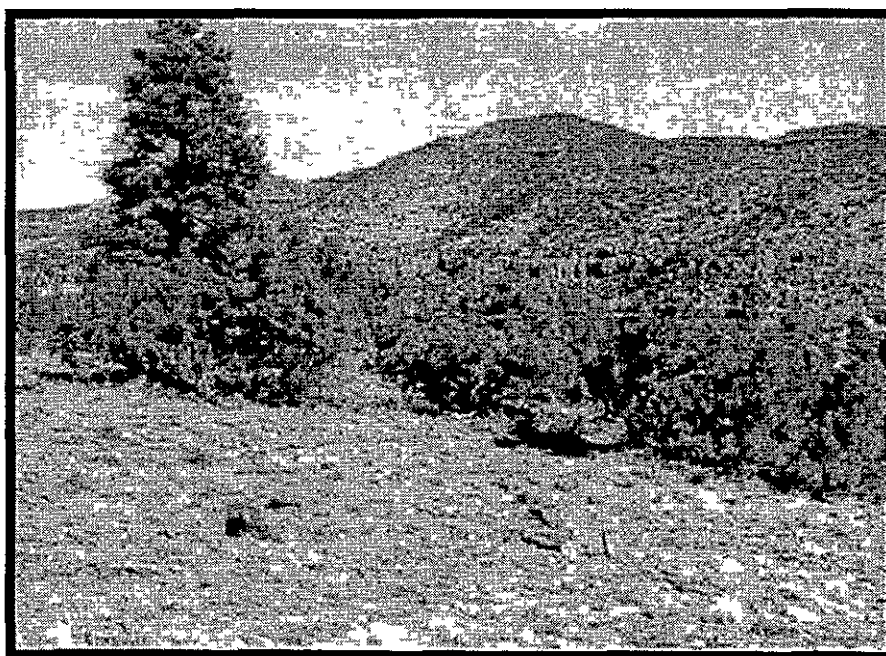
The team debated the significance of livestock-grazing impact, since there would have historically been large ungulates (bison, elk, deer, and bighorn sheep) grazing these areas. The team felt that the annual, frequent clipping of vegetation by domestic livestock may have exceeded the pattern of herbage use by native ungulates in these ecosystems.

There is little mention in the historical data on the Forest of large fires in pinyon/juniper ecosystems, compared with those occurring in Engelmann spruce ecosystems.

1907



1990



RETAKE PHOTO: **1990 PHOTO POINT 11**
ORIGINAL PHOTO: **1907 PHOTO #76956**

Location

Photo Point 11 displays a large burn that occurred in Burro Creek on the Divide Ranger District. Emphasis is on the south and southwest aspects in Sections 13 and 24, T.38N, R.4E., NMPM.

Access

Access to photo point 11 is FDR 330 (Pinos Creek Road). The photo point is 2.1 miles south of the bridge crossing the West Fork of Pinos Creek, at the confluence of the East Fork of Pinos Creek. Photo point 11 is not exactly at the original 1907 photo point location, but does display the same burn area, plus additional surrounding landscape.

Description

The burn featured at this photo point and described by the 1907 photographer occurred around 1860. Additional conifer regeneration, mostly Douglas-fir and bristlecone pine, has come in on the lower-elevation south and southwest aspects. Aspen is still prevalent on the north aspect, but is being replaced by Douglas-fir on drier sites and mostly by Englemann spruce elsewhere. Some of the dry south and southwest aspects are still lacking adequate tree regeneration. Mountain mahogany and scattered bristlecone pine are the predominant cover on these severe sites.

Team Comments

The 1907 photo shows snags still evident 50 years after the fire (look at the right side of the skyline). The 1907 photograph shows a landscape that was extensively burned. The foreground was dominated by aspen when the photograph was taken. There has been a marked increase in conifer, mostly from conifer stand centers that were evident in the 1907 photograph (look at the left-center of the photos). High, harsh sites in the photographs do not appear to have changed much. Conifers replacing aspen indicates that succession is moving towards the conifer potential on the site.

Soil erosion does not appear to be occurring on the ridge side in the foreground of the original 1907 photograph. It is not possible to determine soil erosion rates for the area in the rest of the photograph, or in the 1990 photograph, because of their large scale.

1907



1990



RETAKEN PHOTO: **1990 PHOTO POINT 10**
ORIGINAL PHOTO: **1907 PHOTO #76957**

Location

Photo Point 10 is in lower West Pinos Creek near its junction with East Pinos Creek, on the Divide Ranger District, in the south 1/2 of Section 1, T 38N , R 4 1/2E, NMPM.

Access

Access is FDR 330 (Pinos Creek Road) to the private road at West Pinos Creek. Go up West Pinos Creek Road 0.2 mile to the old homestead log barn. Proceed north up the steep ridge to the photo point (approximately 400 feet).

Description

This photo point features an open pinyon timber type on a steep, south-facing slope. It appears there has been increased mortality since the 1907 photo was taken. The grass and forb ground cover is heavier now than when the original photo was taken. The pinyon trees appear less vigorous than in the original 1907 photo.

Team Comments

Pinyon pine appears to be declining in vigor, though it is quite localized. Increased mortality since the 1907 photograph may be due to root rot. There is more grass and forb ground cover in the 1990 photograph than in the one taken in 1907. The team could not discern whether there was a change in shrub density. The team speculated that fire may be subordinate to root rot in this localized area. The low fuels and rocky/gravelly soils probably kept ground fires spotty and small. Pinyon pine stand-replacement fires are probably extremely infrequent on this site. Increased grass and forb ground cover has reduced soil erosion, but it is still occurring. These photos show very rocky soil.

1907



1990



RETAKE PHOTO: **1990 PHOTO POINT 7**
ORIGINAL PHOTO: **12/14/1907 PHOTO #76969**

Location

This photo point is in lower Raspberry Gulch near Elk Park, on the Divide Ranger District, in Section 26, T40N, R2E

Access

Access is via trail 830 up Raspberry Gulch, about 1/3 mile south of Elk Park. A 4WD road from FDR 430, which is along the east side of Elk Park, accesses trail 830. Offset Point 7 can be driven to by 4WD and is located where the 4WD road ends and trail 830 starts.

Description

This photo point shows a burn in Douglas-fir that occurred around 1892. Some of the fire-killed Douglas-fir was logged after the burn. The burn area, on a northwest aspect, has completely regenerated to Douglas-fir, with areas of aspen on benches and near the stream bottom. Some Englemann spruce has come in along the stream bottom. Diameters of Douglas-fir regeneration are 3 to 7 inches. Most of the aspen regeneration is 5 to 10 inches in diameter.

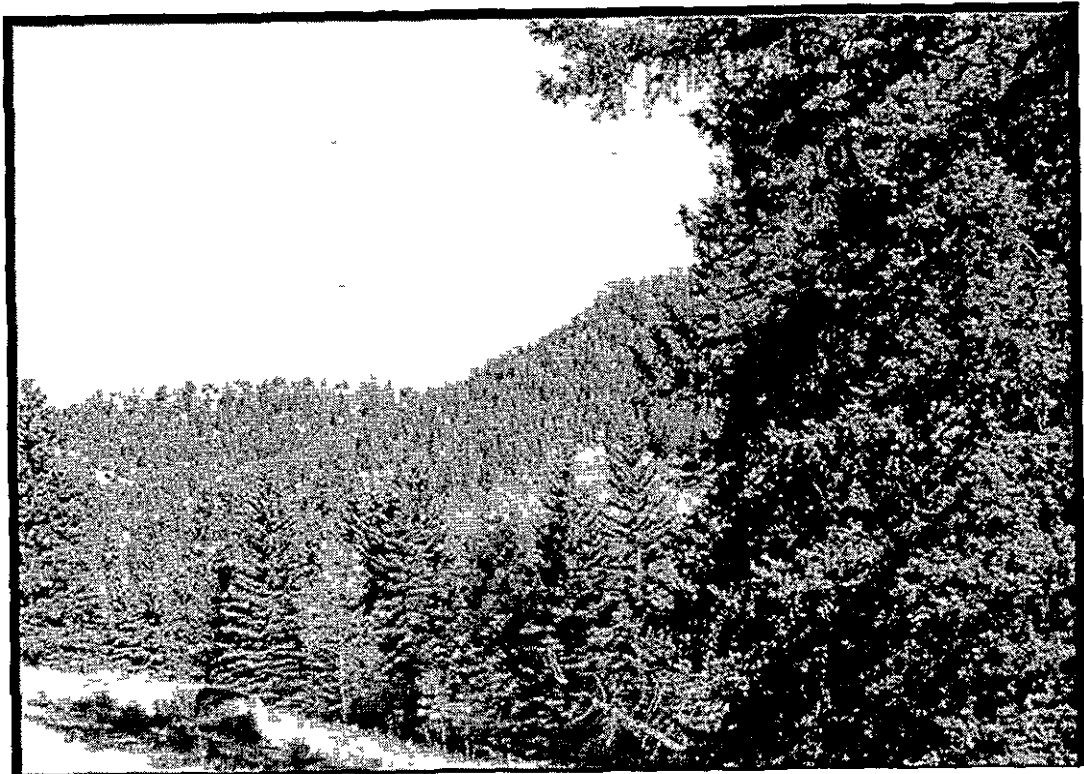
Team Comments

Aspen increased on better sites, rather than Douglas-fir. The aspen may be surviving on cooler, wetter sites, as opposed to drier hillsides where aspen clones may have been totally killed. Shady micro-sites, provided by standing dead trees with reduced wind movement, may have encouraged conifer reproduction and establishment. Moderate to high levels of soil erosion occurred on this site after the fire and subsequent logging. There is downed woody debris in the foreground, and standing dead trees throughout the remainder of the original photo, which prevent excessive soil erosion.

1907



1990



RETAKE PHOTO: **1990 PHOTO POINT 6**
ORIGINAL PHOTO: **1907 PHOTO #76972**

Photographers Comments

Location

This photo point is in lower Haney Canyon near Elk Park, in the east 1/2 of Section 14, T 40N , R.2E , NMPM

Access

Access is via a private road (Road 430 on maps) that accesses Elk Park. Take road 430 to Section 24, T.40N , R.2E , then, at a junction near an old homestead, proceed up Haney Gulch via 4WD road to the Forest boundary in Section 14. Photo Point 6 is northwest of Haney Gulch on a gentle grassy bench

Description

This photo point features some old tie logging that occurred in 1882, 25 years prior to the photo Logging was primarily in ponderosa pine

Very little tree growth has taken place since 1907. Some young ponderosa pine saplings have come in, but their slowness was probably due to lack of seed source, the old logging removed most of the good seed trees. *The ground cover of grasses and forbs appear much heavier now.* Currently the area is not grazed. Aspen has died or been cut. It has been replaced with a heavier, younger, and denser stand of young aspen

Team Comments

It appears that ponderosa pine regeneration has been light (you can see some regeneration in the right-center of the photo) Aspen appears to have increased over time, especially in the left-center of the photo The bluff in the background appears to have a higher tree density in the 1990 photo The ridge horizon is very close to the original photo

The 1907 photo shows a grassland community (Arizona fescue) in the foreground that appears to have been heavily grazed The 1990 photo shows a much more vigorous community, but we could not judge if the basal area of Arizona fescue was actually different The photo alignment may not be precise in the foreground (the stump behind the nearest stump in the 1907 photo is missing in the 1990 photo)

Soil erosion appears to have decreased from the high levels of the 1907 photo, due to *increased vegetative ground cover.*

1907



1990



RETAKE PHOTO: **1990 PHOTO POINT 4**
ORIGINAL PHOTO: **9-14-1903 PHOTO #39873**

Location

This photo point is on the East Fork of Willow Creek, near Creede

Access

To get to Photo Point 4, go 3.9 miles north on FDR 502. Approximately 150 feet north is Photo Point 4. An offset photo point was also made about 170 feet to the east of Photo Point 4.

Description

Photo Point 4 features a large burn that occurred in the East Fork of Willow Creek sometime prior to 1903. The original photo focused on a portion of the burn in the creek bottom where an area of mature Douglas-fir trees burned. Some of the fire-killed trees were subsequently logged, probably for mine props or ties.

Regeneration on south aspects is sparse and the majority is aspen. Eastern and northern exposures are being reforested with conifers (Douglas-fir at lower elevations and Englemann spruce over 10,500 feet). Much of this burn was on some harsh (dry and windy) sites, and it may be another 150 years before all the burned area is reforested.

Team Comments

The photo series documents that certain harsh forested sites do not readily regenerate with forested cover. Some type conversion has occurred, as evidenced by stumps still apparent within grassland habitat in the 1990 photo. The 1903 photo shows some young aspen in the drainage, which are still present today.

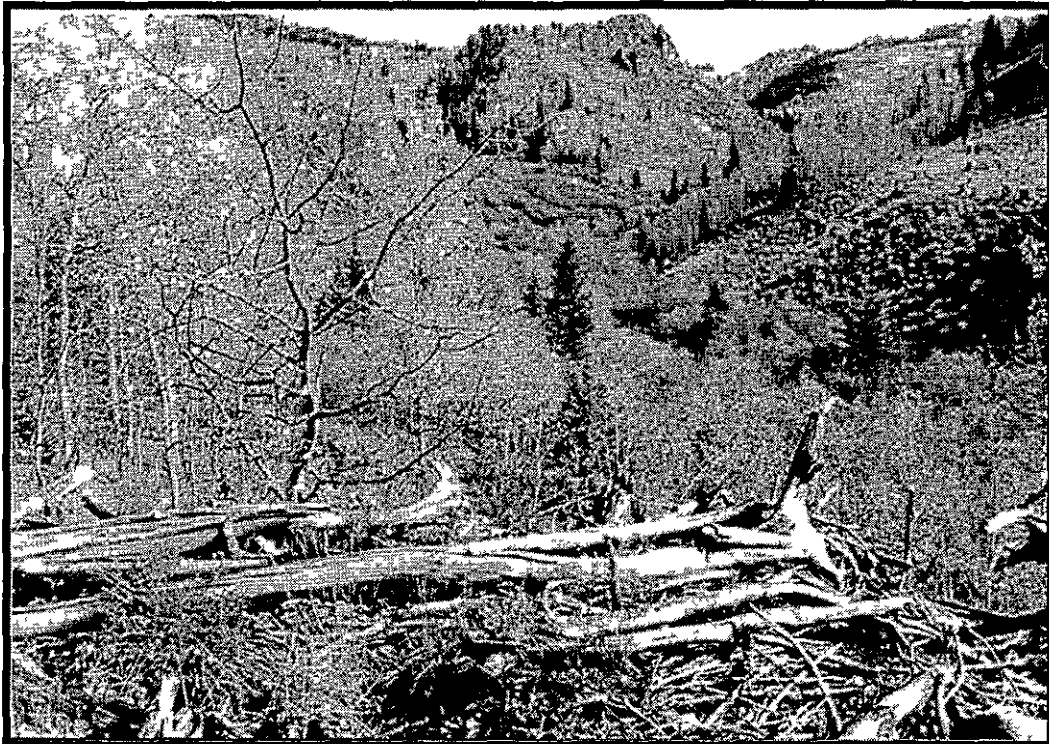
The team estimated that the fire may have occurred 10 years before the 1903 photo (circa 1893, which may have been part of a dry cycle in the climate). Note mine on the left side of the 1903 photo.

Severe soil erosion occurred on the steep, bare slopes shown in the original photo. On the south aspect, where regeneration is sparse, erosion is still occurring. Additionally, soil is eroding in the rocky clearcut area in the center of the 1990 photo.

1903



1990



RETAKEN PHOTO: 1990 PHOTO POINT 3
ORIGINAL PHOTO: 8-4-1909 PHOTO #78374

Location

Photo Point 3 is north of Snowshoe Mountain along along Colorado 149, near Creede, where FDR 600 joins Colorado 149 in Section 26, T 41N., R. 1E , NMPM

Access

Access to Photo Point 3 is via Colorado 149 to its junction with FDR 600. The photo point is about 150 feet uphill from the road sign for FDR 600. Go 150 feet uphill along the old fence line. The photo point is about 15 feet north of the fence line

Description

These photographs feature a panoramic view of the north side of Snowshoe Mountain. The original views here were photographed on 8/4/09 by C. G. Bates. When comparing the original photo to the 1990 photographs, the main difference is an increase in the density and area of conifer trees. Most acres of aspen still remain as aspen. Conifer invasion seems to be relatively slow compared to some other north slopes.

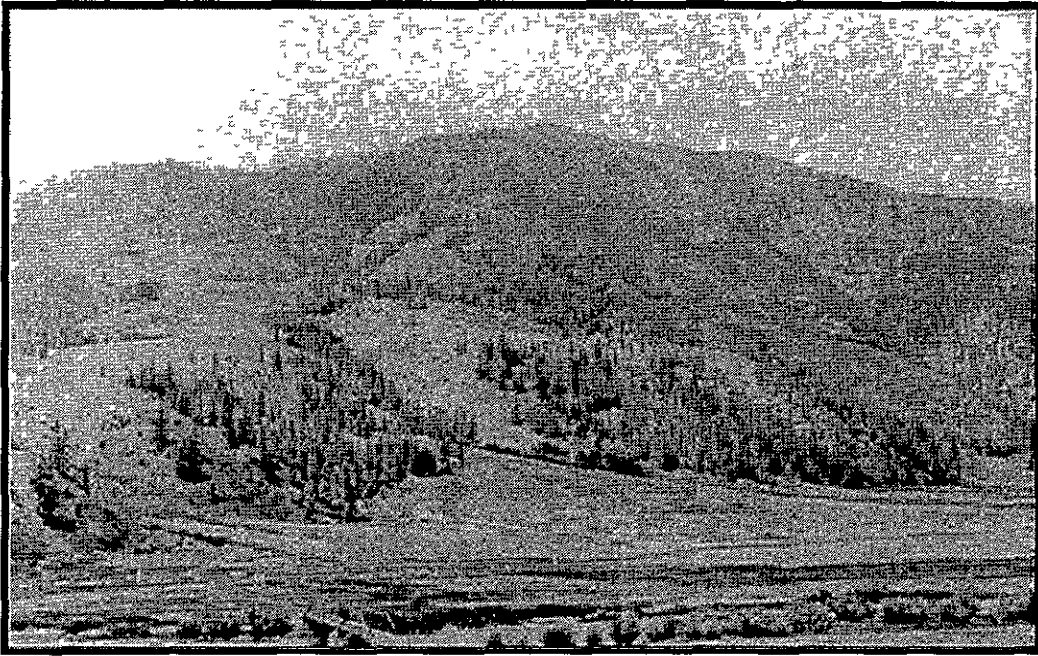
Team Comments

The basin in the upper-right side of the photo is the Wagon Wheel Gap Experiment area that was clearcut 1919-20. We also have a photo from 1940 that can be used for comparison.

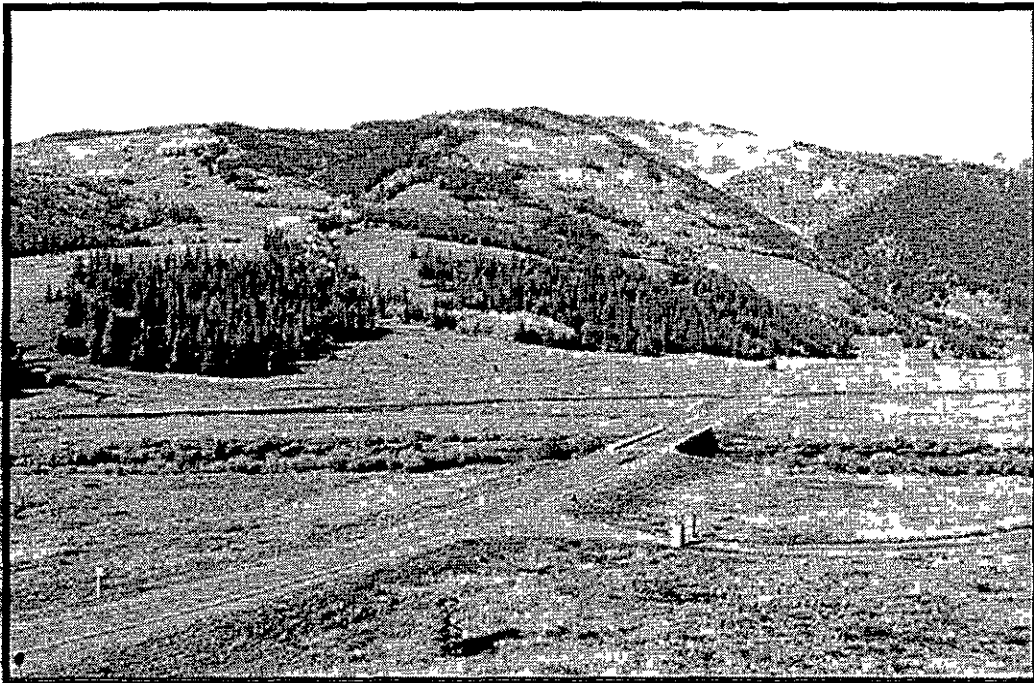
A mixed aspen/conifer stand in the left-center of the 1909 photo has filled in to conifer. Overall, there has been a marked increase in conifer throughout. Conifer appears to establish in small depressions on the slopes in the photo. Once a small group of conifers becomes established, they seem to form the nucleus for outward expansion. Conifers appear to be coming back into the Wagon Wheel Gap watershed, encroaching into small meadows on the hillside. Aspen appear to be encroaching also, and the meadows appear relatively dry.

Willow in the riparian zone appears to have increased in density substantially along the Rio Grande. The foreground in the 1909 photo appears heavily grazed. There is a noticeable paucity of willows along the river in the fenced portion seen in the left-center of the photo.

1909



1990



RETAKE PHOTO: **1990 PHOTO POINT 2**
ORIGINAL PHOTO: **3-16-1907 PHOTO #71263**

Location

Photo Point 2 is about a mile upstream from Palisade Campground, on the Divide Ranger District, on a south-facing slope several hundred feet above the Rio Grande, in Section 32, T 41N., R 1E., NMPM

Access

To get to photo point 2, go 3.6 miles east of the "Wagon Wheel Gap" sign on Colorado 149, to a powerline crossing the highway. At power pole 179, go north approximately 500 feet up a draw.

Description

Photo Point 2 shows a ponderosa pine stand interspersed with some Douglas-fir that was logged immediately prior to 1907. Logging was heavy and left few good seed trees. Some groups of advance regeneration are present.

The 1990 photo indicates that Douglas-fir has filled in and taken over the site, excluding much of the ponderosa pine. Most of the released or regenerated Douglas-fir is probably the result of fire suppression since the area was logged.

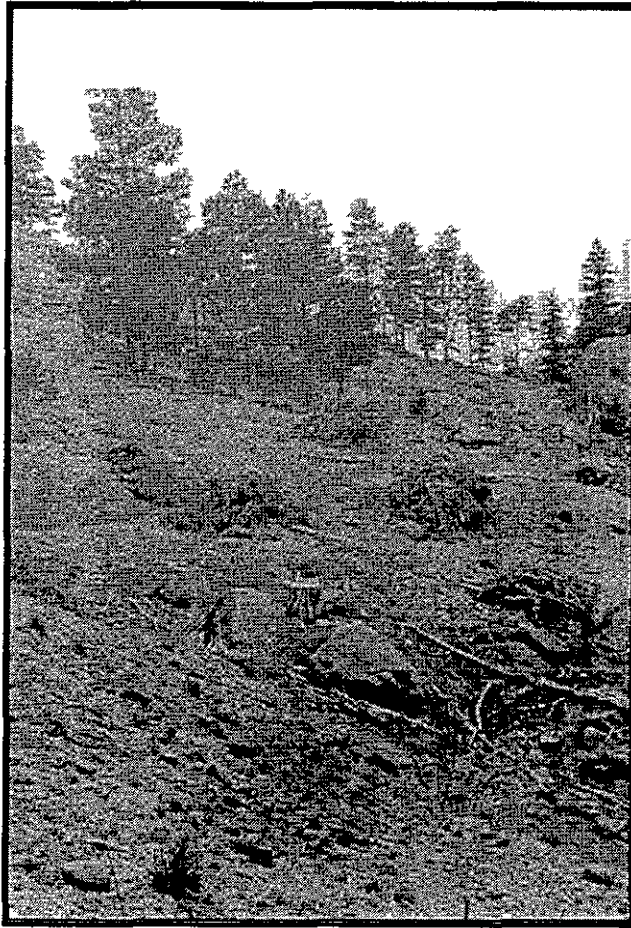
Most of the current and well-spaced trees are 5 to 8 inches in diameter and appear as thrifty as the more open original stand. This area has rapidly progressed to climax conditions since 1907.

Team Comments (Note the stump with the hole in the middle for photo alignment).

The 1907 photo shows a site that was recently cut over, with some slash-piling. The site appears to have been dominated by ponderosa pine, with some Douglas-fir. The 1990 photo shows impressive site recovery in terms of Douglas-fir growth. It appears that fire suppression, or a lack of natural fires in this area, has allowed the site to convert to Douglas-fir. It is known that Douglas-fir will increase on the better ponderosa pine sites where fire is excluded.

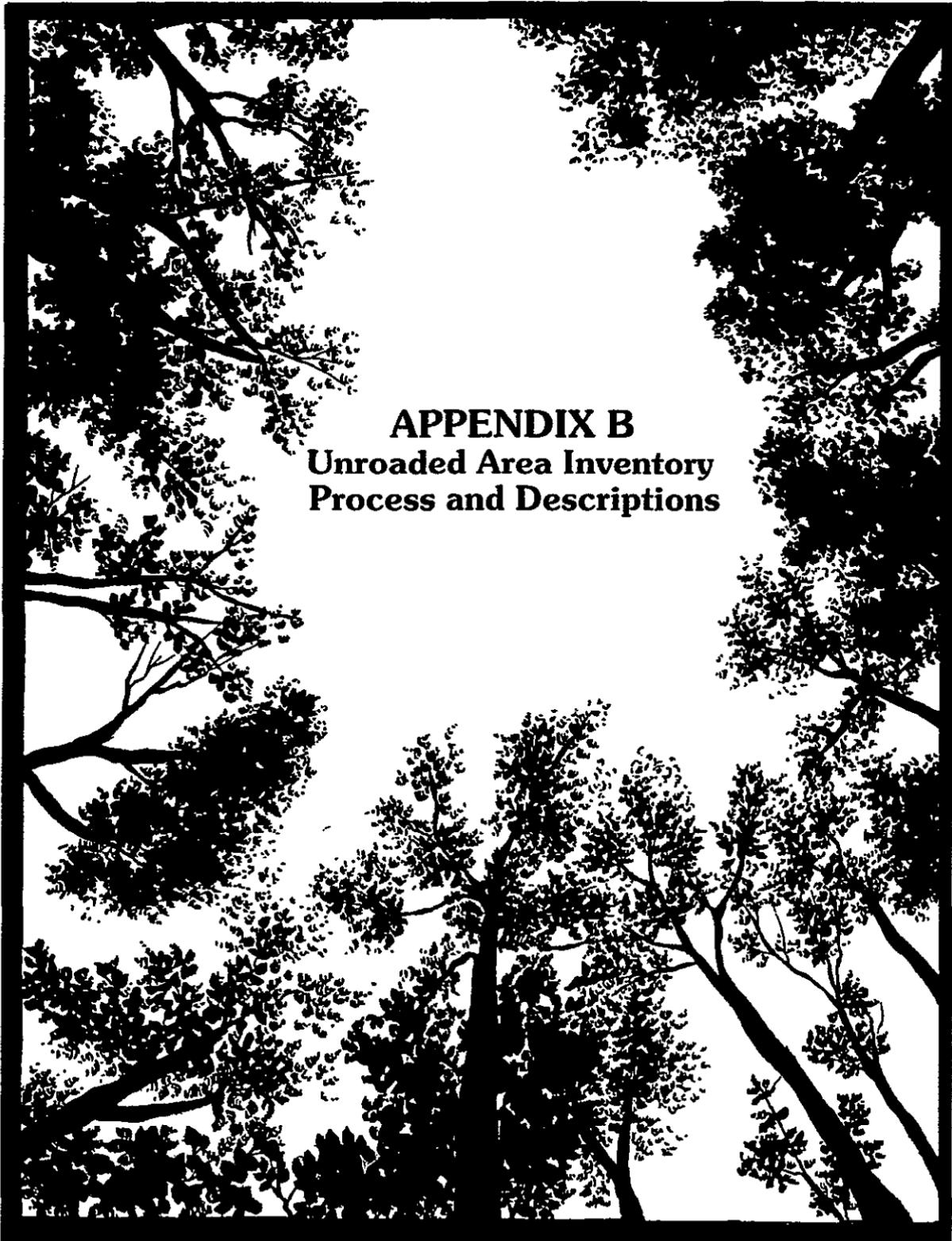
High levels of soil erosion occurred at this site after the logging, just before the 1907 photo was taken, and soil erosion is still occurring.

1907



1990





APPENDIX B
Unroaded Area Inventory
Process and Descriptions

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APPENDIX B

Unroaded Area Inventory Process and Descriptions

I. INVENTORY PROCESS

A. Inventory

Identify all roadless and undeveloped areas

B. Criteria for Roadless Areas

- 1 Areas contain 5,000 acres or more
- 2 Areas contain less than 5,000 acres but
 - a Due to physiography or vegetation, areas are manageable in their natural condition.
 - b. Areas are self-contained ecosystems.
 - c Areas are contiguous to existing wilderness, primitive areas, administrative endorsed Wilderness, or roadless areas in other Federal ownership, regardless of size
- 3 Areas do not contain improved roads maintained for travel by standard passenger-type vehicles

C. Criteria for Including Improvements

1. Airstrips/helisports
2. Cultural treatments (planting where use of mechanical equipment is not evident)
- 3 Minor electronic installations (repeaters, etc which have minimal impact)
- 4 Historic mining (50 + years) includes
 - a prospecting where holes were dug without access roads,
 - b areas covered by mineral leases with no surface occupancy, and
 - c areas covered by mineral leases with no development or occupancy rights
- 5 Minor structural range improvements (fences, water ponds)
6. Harvest areas where logging and prior road construction are no longer evident
7. Ground-return telephone lines, if rights-of-way have not been cleared
- 8 Watershed treatment areas if the use of mechanical equipment is no longer evident.

D. Roadless Area Narratives - Outline

The summary descriptions of the roadless areas contain information found in the first group of items.

Area Name (Assign area number)

Acreage

Access Routes - state how area is accessed (Forest roads, trails)

Remoteness - distance from roads, type of access, accessibility to the area

Natural Integrity - the degree to which past or present human activity has affected the natural ecological processes or conditions

Apparent Naturalness - assess the areas current physiological landscape condition

Solitude - outline the recreation setting and best chance for solitude.

Recreation - describe the area's capability of providing a various unconfined recreation opportunities (camping, fishing, hiking, etc)

This second group of items contains information found in the more detailed descriptions of the roadless areas, which are available upon request

Wildlife - describe the type of wildlife in the area and if any TES are known to inhabit the area.

Grazing Situation - describe allotments within the area

Suitable Timber - list timber types and potential for harvest.

Mineral Potential - list any known mineral potential the area may have

Special Features - describe what it is that brings visitors to the area. List any attributes which need managing or preserving (ecological, scientific, scenic, cultural, historical)

Manageability - describe the ability to manage the area, any adjacent land activities and can the areas landscape and resource values be protected.

E. Evaluation Process (Winter - 1994)

Based on the write-up provided by the District, an evaluation of each unroaded area was done based on the area's attributes (capability, manageability, and suitability) These attributes are reflected in the attached summary definition sheets and capability/ manageability chart

The area's capability is based upon the degree to which the area currently exhibits the characteristics outline in the Wilderness Act. Factors include the area's natural appearance and integrity, opportunities for solitude and unconfined recreation

The area's manageability is based upon the ability to manage the area in its natural condition; the area's accessibility and whether encumbrances or resource conflicts exist. Factors considered are adjacent land uses, type of access within the area and past or current human activity

The areas suitability is based upon maintaining or enhancing the area's attributes. Factors include it's natural environment, opportunities for challenge and recreation, any special features within the area and its ecological condition

Unroaded areas that are suitable for wilderness must also meet the criteria of availability and need. Availability takes into account

1. the value of and need for the area as wilderness compared to value of and need for other resources,
2. constraints and encumbrances on the land, and

3. the effect wilderness designation and management is likely to have on adjacent lands

A Wilderness Needs Assessment was prepared by the Rocky Mountain Regional Office related to landtype associations represented in the National Wilderness Preservation System. This assessment identified the need to have under represented landtype associations considered when recommending areas for inclusion into the National Wilderness Preservation System.

F. Recommendation Process

The above criteria were used in the Forest Plan Revision process to decide the disposition of each unroaded area by alternative

II. INVENTORIED UNROADED AREAS ATTRIBUTE DEFINITIONS

A. Capability Characteristics:

1. Size of area and juxtaposition to a Wilderness area.
 - High - 5,000 acres or larger and adjacent to a Wilderness area
 - Medium - 5,000 or less and adjacent to a Wilderness area
 - Low - 5,000 acres or larger and not contiguous with a Wilderness area
2. Area provides elements of biological diversity and naturalness, including unique habitats; TE&S species habitat, numerous riparian areas; habitat corridors, or existing old growth
 - High - has critical or unique habitats and diverse ecological conditions
 - Medium - has a mix of habitats and ecological conditions.
 - Low - has limited ecological conditions and habitats
3. Area provides challenging recreation opportunities.
 - High - lacks trail system or trails maintained every 3-5 yrs
 - Medium - trail system and trails maintained every 2-3 yrs
 - Low - trail system and trails maintained every 1-2 yrs
4. Area contains a variety of natural resources, including a variety of tree species and structures, intermingled grasslands or meadows, numerous recreation opportunities, diversity of wildlife habitats and wildlife, etc.
 - High - diverse amount of natural resources
 - Medium - mix of natural resources
 - Low - limited amount of natural resources
5. Area contains outstanding scenery or distinct features like lakes, waterfalls, rock formations, panoramic views, etc.

High - Many distinct features
Medium - Some distinct features
Low - One or no distinct features.

6. Area has potential for scientific research, environmental educational, or historic/cultural opportunities

High - good potential for two or more opportunities
Medium - potential for one type of opportunity
Low - little or no potential for this type opportunity

B. Manageability Characteristics:

1. Ability to manage the area in an unroaded condition, including distance and influence from outside activities, opportunity to access the area, resource conflicts or encumbrances

High - isolated area away from areas of activity; controlled or limited access, no encumbrances or resource conflicts.

Medium - somewhat isolated from areas of activity, adequate access opportunities; some resource conflicts and/or encumbrances.

Low - area not isolated from outside activities, area is easily accessible, and, numerous resource conflicts or encumbrances

- 2 Motorized use within the area.

Yes - has motorized vehicle use.

No - does not have any motorized vehicle use

- 3 Area has current or past amounts of human activity

High - obvious evidence of human activity.

Medium - unnoticeable or unobjectionable human activity.

Low - little or no evidence of human activity

Table B-1. Unroaded Area Evaluation

AREA NUMBER	AREA NAME	CAPABILITY CHARACTERISTICS						MANAGEABILITY CHARACTERISTICS			RATING
		1	2	3	4	5	6	1	2	3	
020901	Chama Basin	H	H	M	H	H	M	M	Y	M	H
020903	Cumbres	H	M	M	M	M	M	L	Y	M	M
020906	Spruce Hole / Sheep Creek	L	M	H	M	L	L	H	N	H	M
020907	Fox Creek	L	H	M	H	H	M	H	Y	M	M
020911	Conejos River / Lake Fork	M	L	M	L	L	L	M	N	M	L
020912	Summit Peak / Elwood Pass	M	M	M	H	M	L	M	N	M	M
020913	Stunner Pass / Dolores Canyon	M	M	M	M	M	L	H	N	L	M
020914	Wightman Fork to Lookout	L	M	H	L	L	L	M	N	L	M
020920	Silver Lakes / Stunner	L	M	M	M	M	L	L	N	L	M
020923	Tobacco Lakes	M	M	M	M	L	L	M	N	L	M
020925	GoldCreek / Cascade Creek	M	M	M	M	M	L	M	N	L	M
020931	La Garita	L	M	M	M	M	M	M	Y	M	M
020946	Tewksberry	L	M	M	M	L	L	M	Y	L	L
020948	Fox Mtn	L	M	M	M	M	L	M	Y	M	L
020949	Gibbs Creek	M	M	M	M	M	L	M	N	M	M
020950	Kitty Creek	M	M	M	M	L	L	L	N	M	L
020951	Wason Park	M	H	M	H	M	M	H	Y	M	M
020954	Snowshoe Mtn	H	M	M	M	M	M	H	Y	L	M
020955	Red Mtn	M	M	M	M	M	L	H	N	L	M
020956	Copper Mtn / Sulphur	H	M	M	M	L	L	L	Y	M	L
020957	Ruby Lake	H	M	M	M	L	L	M	Y	M	L
020959	Pole Mtn./Finger Mesa	L	M	M	M	M	M	H	Y	M	M
020960	Big Buck / Kitty / Ruby	L	M	M	M	M	L	M	Y	L	M
020961	Beartown	M	M	M	M	L	L	M	N	L	M
020964	Box / Road Canyon	M	L	M	L	M	L	M	N	M	L
020975	Bristol Head	L	M	M	M	M	M	M	Y	M	M
020978	Lower East Bellows	M	M	H	L	M	L	M	N	M	M
0209A2	Sawlog	L	M	M	M	L	L	M	N	M	M
0209A5	Sheep Mtn	H	M	H	M	M	L	H	Y	L	M
0209A7	Lake Fork	H	M	M	M	M	L	M	Y	M	M
0209A8	Fourmile Creek	L	M	M	M	L	L	L	Y	M	L
0209A9	Taylor Canyon	L	M	M	L	L	L	L	N	M	L

0209B3	Antora Meadows/Bear Cr	L	M	M	M	L	L	M	Y	M	M
0209B8	Ute Pass	L	M	M	M	L	L	M	N	M	M
0209B9	Elkhorn Peak	L	M	M	M	L	L	M	Y	M	L
0209C2	Dorsey Creek	M	M	M	M	L	M	L	N	H	L
0209C3	Butterfly	M	M	H	M	L	M	M	N	M	M
0209C4	Miller Creek	M	M	H	M	L	M	M	N	M	M
0209C5	Cotton Creek	M	M	M	M	M	M	M	N	M	M
0209C6	Crestone	L	M	M	M	M	L	H	N	M	M
0209C7	Pole Creek	M	M	M	M	M	M	H	N	M	M
0209C8	Hot Springs	M	M	M	M	L	L	M	N	M	M
0209DA	Trout Mountain	M	H	M	H	M	M	H	Y	M	H
0209DE	Beaver Mountain	L	M	M	M	M	L	M	Y	M	L
0209DI	Middle Alder	L	M	M	M	L	L	M	Y	M	L
0209M1	Wightman Frk/Upper Burro	L	M	H	M	M	L	M	Y	L	M
0209M2	Bennet Mtn	L	H	M	H	M	M	M	Y	L	M
	Blowout/Willow Crk	L	M	M	M	L	L	M	N	L	M
	Lion Pnt/Greenie Mtn	L	M	H	H	M	M	H	N	L	H
0209M3	Deep Creek	H	M	M	M	M	M	M	Y	M	M
	Boot Mtn	L	M	M	M	M	M	M	Y	M	M
0209P1	Spectacle Lake	M	M	M	M	L	L	L	M	N	L
0209Q2	Willow Mountain	L	M	M	H	M	H	M	Y	M	H
0209Q3	Alamosa River	L	M	L	L	L	L	L	Y	M	L
0209RA	Sulphur Tunnel	M	M	M	M	L	L	L	N	M	L
0209RE	Indian Ridge	M	M	H	M	L	L	M	N	M	M
209	Cochetopa Hill	L	M	M	M	M	M	M	N	M	M
211	Manchego	L	M	H	M	L	L	H	N	M	M
215	Mineral Mountain	L	L	M	L	L	L	M	Y	M	L
217	Middle Fork	M	M	M	M	L	L	L	Y	M	L
220	Carson Peak	M	M	M	M	M	M	M	Y	M	M
BLM	Handies Peak	RECOMMENDED NONWILDERNESS									
INDEX -- WILDERNESS SUITABILITY H = HIGH M = MEDIUM L = LOW											

C. Area Descriptions.

The following section contains summaries of the descriptions of the Forest's 47 unroaded areas. These summaries are provided to give the reader an overview of each unroaded area's existing condition, capabilities, and manageability. A complete write-up for each unroaded area is part of the planning record and copies are available upon request. The more complete write-ups contain information on items like timber, grazing, mining, and features of special interest.

Chama Basin (020901) / Cumbres (020903)

Acres: Chama Basin - 21,729 and Cumbres - 10,566

Access Routes:

Chama Basin: Forest Development Road (FDR) 121, a level 2 road, accesses the western portion of the Chama Basin Area from the south. A jeep route accesses the area from the Tierra Amarilla Grant (private land). Three Forest Development Trails (FDTs) (740, 741, and 124) provide both motorized and nonmotorized opportunities.

Cumbres: Several access roads border or are adjacent to the Cumbres area boundary, including FDR 118 - Trujillo Meadows Road (level 3 - well maintained), FDR 118.1 - Flat (level 2 - 4WD), FDR 119 - Cumbres (level 3 & level 2), FDR 114.1 - La Manga II (level 3) and FDR 128.1 - Elk Creek (level 2). Several FDTs within the area provide motorized and nonmotorized opportunities.

Remoteness: This area is managed for semi-primitive motorized opportunities with most trails open to motorized use. The various roads and trails provide good access to both areas. Once away from the trails, one can get a feeling of seclusion.

Natural Integrity: Most of these areas have long-term ecological processes that are intact and functioning. There are several cattle and sheep allotments within these unroaded areas. Some evidence of past logging activity (stumps and some reminiscence of old road systems) and past fire activity exists.

Apparent Naturalness: Most of the area is natural in appearance. Chama Basin is characterized as moderate to steep forested mountain slopes with dissected drainages. Vegetation is mainly aspen and Engelmann spruce.

The Cumbres area is characterized by moderate to steep forested mountain slopes with park-like benches and alpine plateaus with long narrow drainages. Vegetation is primarily spruce/fir.

Manageability: The mineral rights in Chama Basin are privately owned. There is interest to explore the area's mineral potential and if exploratory results are good, future development is likely to occur. Once exploration and development occur, the area's natural landscape and primitive character will be difficult to maintain.

Both areas receive use from hikers, horseback users and various motorized (motorcycles and ATVs) users. The Continental Divide trail attracts hikers and mountain bike users. The area

provides good hunting opportunities in late summer and fall. The entire unroaded area would be difficult to manage if motorized opportunities were eliminated.

Spruce Hole / Sheep Creek (020906)

Acres: 7,697

Access Routes: The closest access roads to this area are FDR 107 - Osier (level 2) and FDR 108 - Spruce Hole (level 2) which border the area's south and western boundaries. There are no FDTs within the area. The area is managed for a semi-primitive nonmotorized setting.

Remoteness: Because the area has no trails it provides opportunities for seclusion and solitude.

Natural Integrity: The long-term ecological processes are functioning. The area is undergoing changes (natural open grasslands and areas where trees were planted) because of a significant fire that burned an extensive portion of the Osier country. The upper plateau part of the Cumbres cattle allotment is within this area.

Apparent Naturalness: The area is natural in appearance. It is characterized by large, open grassy areas intermingled with aspen and fir stands in the upper plateau, with many steep and narrow forested (spruce and fir) drainages that slope into the Conejos River.

Manageability: The area receives a very limited amount of use because of the lack of well-established access routes and no trails. The area's primitive and nonmotorized character can be maintained.

Fox Creek (020907), Willow Mountain (0209Q2) & Alamosa River (0209Q3)

Acres: Fox Creek - 6,109
Willow Mountain - 9,948
Alamosa River - 5,063

Access Routes: General access to these unroaded areas is provided by the Alamosa - Conejos River Road (FDR 250) which encompasses these areas on the north, west, and south. Due to the steep terrain associated with the river canyon walls, suitable access routes from FDR 250 are limited. Existing four-wheel drive roads provide closer access. These include FDR 101 - Fox Creek Road (level 2 - 4WD); FDR 240 - La Jara Creek Road (level 2) accessing Willow Mountain, FDR 248 - Jim Creek Road (level 2) and FDR 249 - Bancos (level 2), which access the Fox Creek area, and FDR 259 (level 2) which accesses the Alamosa River area. Both motorized and nonmotorized opportunities are provided on FDTs and non-FDTs. FDR 260 - Silver Lakes Road (level 3) provides access to Willow Mountain on the area's north and west boundary.

Remoteness: These areas are managed for both motorized (Alamosa River/Fox Creek) and nonmotorized opportunities (Willow Mountain). The area is large enough that one can find seclusion and a feeling of solitude once away from the area's trails.

Natural Integrity: The vast majority of these areas have long term, intact, and functioning ecological processes. These roadless areas contain many cattle and sheep allotments.

Apparent Naturalness: These areas are natural in appearance. They are characterized by gentle to steep alpine slopes and ridges with stands of aspen, Engelmann spruce - subalpine fir, Douglas-fir, and ponderosa pine. The forested areas are interspersed with fescue grassland and shrublands.

Manageability: These areas provide a variety of opportunities including hiking, horseback riding, viewing scenery, stream fishing, motorcycling, ATVs, and mountain biking. These areas contain big-game habitat that provides hunting opportunities in the fall. State and BLM land are adjacent to these areas along the area's eastern boundary. Use from the State and BLM lands lends itself for visitors to explore these unroaded areas.

CONEJOS RIVER / LAKE FORK (020911)

Acres: 869 (adjacent to the South San Juan Wilderness)

Access Routes: General access to this area is from FDR 250 - Conejos River Road (level 3) that parallels the eastern boundary. There are no FDTs in this area.

Remoteness: Because of the extremely steep side slopes, access is gained via the Conejos River that flows through the length of this area. Because of the proximity of FDR 250 (sight and sound), one does not get a feeling of seclusion.

Natural Integrity: This area's long-term ecological processes are intact and functioning. Portions of the Conejos Canyon and Bancos cattle allotments are within this area.

Apparent Naturalness. The area appears natural. It is characterized as a long, narrow, and steep-sided canyon with the Conejos River traversing its entire length. The steep-sided canyons have stands of Engelmann spruce and alpine fir interspersed with aspen stands and meadows. Riparian and cottonwood are found by the river.

Manageability: The area provides for nonmotorized opportunities -- fishing and horseback riding are the two main recreation activities. Its primitive and nonmotorized character can be maintained.

SUMMIT PEAK / ELWOOD PASS (020912)

Acres: 3,259 (adjacent to the South San Juan Wilderness)

Access Routes: The closest access routes to this area are FDR 243 - Treasure Creek Road (level 2, 4WD) and FDR 380 - Elwood Pass Road (level 3). The Continental Divide Trail (Trail 813) and Trail 707 provide foot and horseback riding access into the area

Remoteness: This is an isolated area with limited access. The area's semi-primitive nonmotorized setting provides opportunities for seclusion and solitude

Natural Integrity: The area's long-term ecological processes are intact and functioning. Portions of the Elwood and Treasure sheep allotments are within the area

Apparent Naturalness: The area is natural in appearance. Three major drainages (Cataract, Prospect, Iron Creeks) are located within the area. Engelmann spruce/subalpine fir stands comprise most of the area, which is interspersed with open meadows. Tundra makes up the high-elevation areas.

Manageability: Because of the limited accessibility of the area, its primitive character and nonmotorized setting can be maintained. Activities include fishing, hunting, and horseback riding

STUNNER PASS / DOLORES CANYON (020913)

Acres: 2,944 (adjacent to the South San Juan Wilderness)

Access Routes: General access to this area is from FDR 243 - Treasure Creek Road (level 2) and FDR 380 - Elwood Pass Road (level 3) along its northern boundary and FDR 245 - Rio Gato Road (level 3) adjacent to its southeastern boundary. There are no FDTs within this area.

Remoteness: Because of the limited access and lack of FDTs within the area, the semi-primitive nonmotorized setting provides opportunities for seclusion and solitude.

Natural Integrity: The area's long-term natural ecological processes are functioning and intact. The area contains portions of two allotments.

Apparent Naturalness: The area is natural in appearance. The headwaters of the Alamosa River (Gold Creek, Cascade Creek, Dolores Canyon and Treasure Creek) are within this area. Engelmann spruce/subalpine fir stands with interspersed aspen stands comprise the area's vegetative cover.

Manageability: This area provides nonmotorized opportunities with a limited amount of recreational activities (horseback riding, fishing, hunting) occurring because of the lack of FDTs. The primitive character of the area and its nonmotorized setting can be maintained.

WIGHTMAN FORK / LOOKOUT (020914)

Acres: 5,965

Access Routes: The closest access routes are FDR 250 - Alamosa-Conejos River Road (level 3) which is adjacent to this area's southern boundary and FDR 244 - Wightman Fork Road (level 2) and FDR 230 - Summitville Road (level 3) at its northern boundary. There are no FDTs within the area

Remoteness: Because of the limited access and lack of FDTs within the area, the semi-primitive nonmotorized setting provides opportunities for seclusion and solitude

Natural Integrity: The area's long term ecological processes are intact and functioning Portions of three allotments are within the area

Apparent Naturalness: The area appears natural. The area is characterized by steep alpine slopes to very steep alpine drainages with Englemann spruce/alpine fir stands interspersed with open parks. Three drainages are within the area and feed into the Alamosa River

Manageability: The area provides nonmotorized recreational opportunities with very limited activities (fishing and hunting) taking place due to its steep terrain and no FDTs Its primitive character and nonmotorized setting can be maintained.

SILVER LAKES / STUNNER (020920)

Acres: 6,017

Access Routes: Roads within close proximity of this area are. FDR - 250 - Alamosa River Road (level 3) near the area's northern boundary; FDR 260 - Silver Lakes Road (level 2) adjacent to its eastern boundary and FDR 257 - Kerr Lake Road (level 2) providing access near the area's western boundary There are no FDTs within the area.

Remoteness: Because of the limited access and lack of FDTs, one can get a sense of seclusion and solitude when in this area

Natural Integrity The area's ecological processes are functioning and intact

Apparent Naturalness: The area's landscape is natural appearing with no human disturbance The area is characterized as having long and deep forested canyons A majority of the area is comprised of Engelmann spruce/Alpine fir stands with some interspersed Aspen stands.

Manageability: The area is managed for nonmotorized recreational opportunities. Activities include fishing and hunting A large parcel of private land is situated within the area (Cornwalls Nose - Castlemann Gulch) which could make managing the area in its current unroaded condition difficult should private land development or mineral exploration occur

TOBACCO LAKE (020923)

Acres: 3,418 (adjacent to the South San Juan Wilderness)

Access Routes: General access to this area is via FDR 105/100 (level 2) on the area's eastern boundary and FDR 247-T (level 3) adjacent to its western boundary. Only one FDT trail (FDT 150 - Big Lake) (motorized trail) is within the area.

Remoteness: With the very limited access to this area, one can obtain a sense of seclusion and solitude.

Natural Integrity: The area's ecological processes are functioning and intact.

Apparent Naturalness: The area's landscape is natural in appearance with minimal human disturbance. This area is characterized by high-elevation mountainous terrain with Engelmann spruce/alpine fir stands intermingled with large, open meadows and steep drainages sloping into Platoro Reservoir.

Manageability: This area contains numerous parcels of patented land which could affect the management of the area. This area provides semi-primitive motorized opportunities on existing system trails. The area's primitive character and recreation setting can be maintained but will change should access to the private inholdings be pursued.

GOLD CREEK/CASCADE CREEK (020925)

Acres: 865 (adjacent to the South San Juan Wilderness)

Access Routes: This area is accessed via FDR 247 - Three Forks Road (level 3) and FDR 245 - Rito Gato (level 2) which borders the area's eastern boundary. There are two FDTs (FDT 710 & 713) that provide access into the South San Juan Wilderness. These trails are nonmotorized.

Remoteness: With the area being adjacent to the Wilderness and its limited FDTs, one can get a sense of seclusion in this area.

Natural Integrity: The majority of this area has long term ecological processes intact. There is past evidence of historic mining and timber cutting in the area.

Apparent Naturalness: The majority of this area appears natural. This area is characterized by high elevation, mountainous terrain with Engelmann spruce/alpine fir with numerous high elevation parks.

Manageability: This area provides nonmotorized recreation opportunities. The area's primitive character and nonmotorized setting can be maintained.

LA GARITA (020931)

Acres: 12,146

Access Routes: General access to this area is from FDR 670 - La Garita (level 2); FDR 646 - Pinon (level 2) and FDR 795 - Coolbran Canyon (level 2) on its eastern boundary; FDR 650 1 - Lone Rock (level 2) and FDR 650 - Embargo (level 2) on its west boundary and FDR 673 on its northern boundary. Two FDTs (787 and 793) are located in this area and open to motorized use (motorcycles and ATVs).

Remoteness: Because of the close proximity to various roads and the motorized trails within the area one does not get the sense of remoteness or seclusion.

Natural Integrity: The area's long-term ecological processes are intact and functioning.

Apparent Naturalness: This area's landscape is natural appearing. The area is characterized by rolling hills of pinyon-juniper to steep mountainous terrain of Engelmann spruce and fir. Three major drainages are within the area.

Manageability: This area provides semi-primitive motorized recreation opportunities. The area is within a high potential area for oil and gas exploration and mineral potential. The area's primitive character and recreational setting could be maintained depending on the demand for future mineral and oil and gas exploration.

TEWKSBERRY (020946)

Acres: 6,663

Access Routes: General roads within close proximity of this area are FDR 360 - Beaver Creek (level 3), near its north boundary, FDR 380 - Park Creek (level 2) and FDR 361 (level 2) on its south boundary and U S Highway 160 on its west boundary. One motorized trail is within this area.

Remoteness: Because of the area's steep terrain and limited trail system, one can get a feel for remoteness and seclusion.

Natural Integrity: The area's long term ecological processes are intact and functioning.

Apparent Naturalness: The area's landscape is natural in appearance. The area is characterized by steep mountainous terrain with mixed Douglas-fir/Engelmann spruce/fir stands interspersed with Aspen. Tewksberry Creek is the major tributary within the area.

Manageability: The area provides semi-primitive motorized and nonmotorized recreational opportunities. Its primitive character and recreational settings will be maintained.

FOX MOUNTAIN (020948)

Acres: 7,780

Access Routes: Roads within close proximity of this area are FDR 390 - Pass Creek (level 2) and FDR 381 - Fox Mountain (level 2). There are no FDTs within the area

Remoteness: Because of the limited access and lack of FDTs, one can get a sense of remoteness and solitude in this area.

Natural Integrity: The area's long-term ecological processes are intact and functioning

Apparent Naturalness: This area is natural in appearance. This is a high-elevation mountainous area with steep side canyons comprised of Engelmann spruce/alpine fir stands. Several minor drainages are within the area.

Manageability: This area provides nonmotorized recreation opportunities in the summer with snowmobile activity occurring throughout the winter. The area's primitive character and recreation setting can be maintained.

GIBBS CREEK (020949)

Acres: 1,729 (adjacent to the Weminuche)

Access Route: General access to this area is by FDR 410 - Big Meadows road (level 3) and FDR 412 1 - Spruce Creek road (level 2 - currently gated and closed) which access the area's eastern boundary. Forest trail 841 - Gibbs Creek runs the entire length of the area.

Remoteness: Because of the present limited access, this area does provide a sense of remoteness and solitude. Should the area above Big Meadows be re-entered for future sales, this area's sense of remoteness and solitude would be impaired during the sale activity.

Natural Integrity: The area's long-term ecological processes are intact and functioning

Apparent Naturalness: The area is natural in appearance. This is a high-elevation mountainous terrain (steep side slopes) with Engelmann spruce and subalpine fir stands. Gibbs Creek drainage is within the area.

Manageability: The area's natural character and setting can be managed and maintained

KITTY CREEK (020950)

Acres: 1,427 (adjacent to the Weminuche)

Access Routes: Roads within close proximity of this area are FDR 430 - Shaw Lake road (level 2) and FDR 431 - Kitty Creek road (level 2). Portions of Kitty Creek trail (837 - nonmotorized) traverses through this area and Hope Creek trail (838 - nonmotorized) is adjacent to the area's southern boundary

Remoteness: Because of the close proximity of FDR 430 and the use it receives, one cannot get a sense of seclusion (sight and sounds).

Natural Integrity: The area's long-term ecological processes are intact and functioning. There is some evidence of past early century railroad tie cutting occurring in the area which has since recovered naturally.

Apparent Naturalness: The area's landscape is natural appearing. This is high-elevation mountainous terrain with Engelmann spruce/subalpine fir stands and aspen.

Manageability: The area's natural character and recreation setting can be managed and maintained

PALMER MESA/WASON PARK (020951)

Acres: 20,972 (adjacent to the La Garita Wilderness)

Access Routes: The only road access within close proximity of this area is FDR 502 - East Willow Creek (level 3). Numerous (5) FDTs provide motorized and nonmotorized opportunities.

Remoteness: This area is managed for semi-primitive motorized and nonmotorized opportunities. Once away from the FDTs, one can get a sense of seclusion.

Natural Integrity: The majority of the area's long-term ecological processes are intact and functioning. There are several patented mining claims and active mineral prospecting.

Apparent Naturalness: The area is characterized by gentle to steep alpine slopes and ridges, talus slopes, and glacial basins at higher elevation. Mid-elevation is composed of benches (park openings) and steep cliff walls into East and West Bellow Creeks. Major drainages are East and West Bellow Creeks, Farmers Creek, Willow and Whited Creeks. Alpine areas are associated with kobresia/forbs, benches have Arizona Fescue/subalpine fir/Engelmann spruce/Rocky Mountain whortleberry on forested mountain slopes.

Manageability: The area provides motorized and nonmotorized opportunities. Because of the patented mining claims and active mineral prospecting and potential for future access and development on these sites, it will be difficult to manage the area's primitive character and nonmotorized settings.

SNOWSHOE MOUNTAIN (020954)

Acres: 31,766

Access Routes: There are only two roads within proximity of this area FDR 523-Middle Creek road (level 3) borders the eastern boundary and FDR 528-Lime Creek Road (level 3) borders the area's southern boundary There are three FDTs within the area open to motorized use

Remoteness: Because of the size of the area and the terrain, one can get a sense of seclusion and solitude.

Natural Integrity: The area's long-term ecological processes are intact and functioning. Past mining activity in the area was associated with the 1889 Creede silver discovery.

Apparent Naturalness: This area is characterized by moderate to steep forested mountain slopes, benches (open parks) known as Seven Parks and gentle rolling slopes with aspen. Part of the area drains into Goose Creek but the majority flows into Deep Creek The main plant association in the conifer type is Subalpine fir/Engelmann spruce/Rocky Mountain whortleberry and Aspen/Thurber fescue. Plants associated with mountain valleys and openings are willow/sedge and Thurber fescue/Arizona fescue. Major drainages include Lime Creek, Deep Creek, Pierce and Elliot Creeks.

Manageability: The area is managed for motorized and nonmotorized opportunities The area's primitive character and recreation settings can be maintained

RED MOUNTAIN (020955)

Acres: 4,191 (adjacent to the Weminuche Wilderness)

Access Routes: The only road access within close proximity of this area is FDR 526 - Red Mountain Creek (level 2) which borders the western boundary There is only a one-mile section of FDT trail in the area, which is used by hikers and horseback riders

Remoteness: Because of the limited access and lack of FDTs in this area, one can get a sense of remoteness and seclusion while in this area

Apparent Naturalness: This area is characterized by gentle to very steep mountain slopes and ridges Rock outcrop ridges are very steep with accumulation of talus and rock glaciers The main plant association is Subalpine fir/Engelmann spruce/Rocky Mountain whortleberry.

Manageability: This area provides nonmotorized recreation opportunities The area's primitive character and recreation setting can be maintained.

COPPER MOUNTAIN (020956)

Acres: 5,325 (adjacent to the Weminuche Wilderness)

Access Routes: Access is via FDR 523-Middle Creek (level 2) and FDR 524-Copper Creek (level 2) which borders the area's eastern boundary. There are several FDTs available for nonmotorized recreation use.

Remoteness: Because of the close proximity of the access roads, one does not get a sense of remoteness (sight and sounds)

Natural Integrity: The area's ecological processes are functioning and intact. Vehicle access is permitted to the private inholding and is currently in use

Apparent Naturalness: This area is characterized by gentle to steep mountain slopes, moderate to very steep glacial cirques, alpine ridges, talus slopes, and glacial basins. The main plant association in the conifer type is Subalpine fir/Engelmann Spruce/Rocky Mountain whortleberry. Kobresia/forbs are associated with the alpine slopes and ridges. Drainage bottom and openings have willow and sedges.

Manageability: The area's natural characters and recreation setting can be maintained

RUBY LAKE (020957)

Acres: 6,987 (adjacent to the Weminuche Wilderness)

Access Routes: Access is via FDR 522-Fern Creek (level 2) which borders the area's eastern boundary. There is one FDT that accesses the lake and the Wilderness. The trail up to the lake is open to motorized use.

Remoteness: With the limited access and low density of system trail, one can obtain a sense of seclusion and solitude within this area.

Natural Integrity: The area's ecological processes are functioning and intact. There are some remnants of the old road which was associated with past historic logging within the area.

Apparent Naturalness: This area is adjacent to the Weminuche Wilderness and provides motorized and nonmotorized recreation opportunities. This area is characterized by steep glacial cirques, alpine ridges, talus slopes and glacial basins at higher elevation, gentle to steep mountain slopes at mid-elevation and gentle park openings which fan into canyons and valley bottom. Willow and sedges are found in the canyons and valley bottoms; Subalpine fir/Engelmann spruce/Rocky mountain whortleberry are on the mid-elevation mountain slopes with kobresia/forbs on alpine ridges and talus slopes.

Manageability: Other than the lake maintenance needs (use of mechanized equipment) on a scheduled basis, the area's primitive character and recreation setting can be maintained.

POLE MOUNTAIN / FINGER MESA (020959)

Acres: 43,878

Access Routes: Access is via FDR 520-Rio Grande road (level 3 and 2) which borders the area's southern boundary, FDR 533 - Sawmill Canyon/Finger Mesa (level 2) on the southeast boundary, FDR 516 - Mason Creek (level 3) on the eastern boundary, and FDR 518 - Heart Lake (level 2) at its northeast boundary. There are numerous FDTs in this area that provide motorized and nonmotorized uses.

Remoteness: Because of the area's size and rough terrain, one can get a sense of remoteness and seclusion when in this area.

Natural Integrity: The majority of the area's ecological processes are functioning and intact. There is a patented claim in the Canby Mountain area along with some prospecting activity in the Finger Mesa area. Portions of several grazing allotments are in the area.

Apparent Naturalness: This area is characterized by alpine slopes, to very steep alpine ridges, talus slopes, and glacial basins, gentle to steep mountain slopes to floodplain, toe slopes and fans in canyon and valley bottom. Valley bottoms are composed of willow/sedge and Thurber and Arizona fescue. High-elevation areas have Rocky Mountain whortleberry and Kobresia/forbs. Subalpine fir/ Engelmann spruce compose the majority of the moderate mountain slope areas. Major drainages include Pole Creek and Lost Trail Creek.

Manageability: The area's primitive character and recreation settings can be maintained.

BIG BUCK/KITTY/RUBY CREEK (020960)

Acres: 9,763

Access Routes: Access is via FDR 516 - Mason Creek (level 3) and FDR 518 - Heart Lake (level 2), which border the southern boundary of this area. There are several FDTs within the area providing motorized uses.

Remoteness: Once away from the trail system and because of the limited access to the area, one can get a sense of remoteness and seclusion when in the area.

Natural Integrity: The area's ecological processes are functioning and intact.

Apparent Naturalness: This area is characterized by gentle to steep alpine slopes, ridges in the northern portion, gentle to moderate slope with floodplains, toe slopes, and fan in canyons and valley bottom. The alpine ridges have kobresia and forbs with mountain slopes composed of Subalpine fir/Engelmann spruce/Rocky Mountain whortleberry. Valley bottoms

are composed of willow and sedges and Thurber and Arizona fescues. Major drainages include Buck Creek, Kitty Creek, and Ruby Creek.

Manageability: This area is managed for semi-primitive motorized opportunities. The area's primitive character and recreation setting can be maintained.

BEARTOWN (020961)

Acres: 2,411 (adjacent to the Weminuche Wilderness)

Access Route: Access to this area is via FDR 520 - Rio Grande road and FDR 506 - Beartown road (level 2). There are no FDTs within the area.

Remoteness: Because of the limited access and lack of trails within the area, one can get a sense of seclusion and solitude.

Natural Integrity: The area's ecological processes are functioning and intact.

Apparent Naturalness: This area is characterized by east-facing slopes, moderate to steep alpine and mountain slopes, ridges in the southern portion and toe slopes and fan in canyon and valley bottom. Kobresia and forbs are on the alpine ridges. The mountain slopes have Subalpine fir/Engelman spruce with Rocky Mountain whortleberry. Willow and sedges are in the valley bottoms.

Manageability: The area is managed for semi-primitive nonmotorized recreation opportunities. The area's primitive character and recreation setting can be maintained.

BOX/ROAD CANYON (020964)

Acres: 1,259 (adjacent to the Weminuche Wilderness)

Access Route: The only access is via FDR 520 - Rio Grande road (level 3), which borders a portion of the area's northern boundary. There are no FDTs within the area.

Remoteness: Because of the area's close proximity to FDR 520 and the use along this road, one can not get a sense of remoteness or seclusion.

Natural Integrity: The area's ecological processes are functioning and intact.

Apparent Naturalness: This area is characterized by moderate to very steep canyon slopes with rocky, broken, highly dissected terrain on the northern exposures. The main plant associations are Subalpine fir-Engelmann spruce/Rocky Mountain whortleberry, aspen and Thurber fescue.

Manageability: This area is managed for semi-primitive nonmotorized recreation opportunities. Its primitive character and recreation setting can be maintained.

BRISTOL HEAD (020975)

Acres: 46,410

Access Routes: Access is via U.S. Highway 149 along the upper western boundary; FDR 532 - Bristol Head road (level 2) near the middle western boundary, FDR 509 - Santa Maria (level 2) and FDR 508 - Shallow Creek road (level 2) at the southeast boundary, FDR 507 - Miner Creek road (level 2) at the eastern boundary, and FDR 505 - Rat Creek road (level 2) at the northeast boundary. There are extensive Forest trail miles within the area available to motorized and nonmotorized users.

Remoteness: One can get a sense of a sense of remoteness and seclusion within the area.

Natural Integrity: The area's ecological processes are functioning and intact. The area's eastern area has some potential for mineral activity and some prospective drilling has occurred in the McKenzie Mountain area.

Apparent Naturalness: This area is characterized by gentle alpine slopes from Bristol Head and Table Mountain to Snow Mesa, steep cliffs below and south of Bristol Head, gentle to moderate mountain slopes with flood plain, toe slopes and fan in canyons and valley bottoms. The gentle alpine slopes are composed of Kobresia and forbs. The moderate mountain slopes have Subalpine fir-Engelmann spruce/Rocky Mountain whortleberry. Willows and sedges are in the valley bottoms.

Manageability: This area is managed for semi-primitive motorized and nonmotorized recreation opportunities. With the exception of the potential mineral activity that could expand in the McKenzie Mountain area, and the electronic site on Bristol Head, the remaining area's primitive character and recreation settings can be maintained.

LOWER EAST BELLOWS (020978)

Acres: 1,804 (adjacent to the La Garita Wilderness)

Access Routes: FDR 600 - Pool Table road (level 2) is within close proximity of the area's southern boundary. There are no Forest trails within the area.

Remoteness: Because of the limited access, steep terrain and lack of trails within the area, one can get a sense of solitude and remoteness while in the area.

Natural Integrity: The area's long-term ecological processes are intact and functioning.

Apparent Naturalness: This area is characterized by gentle to steep forested mountainous slopes and ridges and is composed of Engelmann spruce/subalpine fir intermingled with benches and side slopes of Idaho, Arizona and Thurber fescues.

Manageability: The area's natural character and recreation setting can be maintained.

SAWLOG (0209A2)

Acres: 10,535

Access Routes: This area is bordered on the west by road #41G, Carnero Pass, which is a level 3 road. Several roads provide access to the northern boundary including #680 (Mann Creek), #680.2B (Royal Park), and #621 (Fullerton Park). There are several miles of former road in the area that were obliterated in 1992.

Remoteness: This area is currently managed for nonmotorized recreation and is accessible by foot or horseback only. The limited access gives the users a feeling of seclusion and inaccessibility.

Natural Integrity: In most of the area, long-term ecological processes are intact and operating. This area was used by sheep for many years; the forb composition in some areas is less than potential. The area was heavily roaded with four-wheel drive tracks made by hunters and wood gatherers, but they have recently been closed and obliterated.

Apparent Naturalness: Except for areas adjacent to constructed developments, the majority of the area appears natural. This area is characterized by gently rolling hills to steep rocky outcrops. Drainages run primarily to the south. Vegetation is comprised of pinyon/juniper in lower elevations, ponderosa pine at mid-elevation, and spruce/fir intermingled with aspen at high elevations. Small to large bunchgrass parks are found throughout.

Manageability: Private and BLM lands adjoin this area along the north, south, and east boundaries. Access is via Lime Creek and Biedell Creek from the BLM, and North Fork Carnero, Poison Gulch, Sawlog Gulch, North Fork, and Royal Gulch via Mexican Park and Fullerton Park from FS lands. The area is very popular with hunters, and owing to a historical, primitive roaded character, it has proved difficult keeping 4WD and ATV use out of this area during hunting season. Last year's hunting season found determined hunters cutting new jeep and ATV routes, and the District has had to focus hunter patrols in the area.

SHEEP MOUNTAIN (0209A5)

Acres: 3,216 (adjacent to the La Garita Wilderness)

Access Routes: This area is bordered on the east by a level 3 road, #787 (South Fork of Saguache Creek). There is also a primitive 4WD road #790 (Big Dry), that extends along the west side for about two miles. There are no FDTs within the area.

Remoteness: This area borders the La Garita Wilderness and lies along an extremely rugged ridgetop, so there is a feeling of inaccessibility and seclusion.

Natural Integrity: In most of the area, long-term ecological processes are intact and operating. Exceptions occur along roads and near range improvements.

Apparent Naturalness: The majority of the area appears natural. Drainages run east and west into Saguache Creek. The area is a high plateau with steep sides. Vegetation is predominantly spruce/fir with aspen stringers and small parks.

Manageability: The area is somewhat V-shaped with the western portions adjacent to Wilderness. No private lands are contained within it. It could be added to the La Garita Wilderness and managed for pristine roadless character.

LAKE FORK (0209A7)

Acres: 10,804 (adjacent to the La Garita Wilderness)

Access Routes: There is one FDR 4WD road #776 1A (Table Mountain) that extends three miles through this area. Access is restricted to permitted use by a water-users group. Other non-FDR jeep roads are present.

Remoteness: This very large area adjacent to the La Garita Wilderness Area has one restricted 4WD road extending into the area and a few primitive roads. This gives the area a feeling of seclusion and inaccessibility.

Natural Integrity: For the majority of the area, long-term ecological processes are intact and operating. Exceptions occur along roads and the more heavily used trails. Traces of timber salvage haul roads are evident. This area had extensive natural fires approximately 100 years ago, creating large aspen stands and mountain-bunchgrass parks.

Apparent Naturalness: Most of the area appears natural. A water diversion is located within the area. The area is characterized by a large plateau in the northern portion. Vegetation is mainly spruce/fir associations with aspen stands and mountain meadows. Drainages run primarily to the east and north.

Manageability: This area is adjacent to the La Garita Wilderness along the western and southern boundaries. It is dissected by several drainages including Lake Fork Saguache Creek, Miners Creek, North Fork Saguache Creek, and several minor drainages. The southern portion could easily be absorbed into the Wilderness, as roadless character is mostly intact. Man's activities are reflected in minor ways, e.g., pack trails north and south of Lake Fork Saguache Creek. The northern half is not so easily managed for roadless character; it contains primitive roads in and near Miners Creek and North Fork Saguache Creek. The northern area is gently to moderately sloping, and access is found along the northern boundary on system road #776 (accessible by ATVs and 4WDs). Some resistance from permittees could be expected if road access is denied. Wilderness policy would be difficult to enforce in this area due to easy motorized access, current permittee use, and existing primitive roads.

FOURMILE CREEK (0209A8)

Acres: 10,487

Access Routes: This area has two Forest Roads providing access to this area. Forest Road 740 - Fourmile Creek (level 2) and Forest Road #736 - Duckfoot Creek (level 2). There are two Forest trails within this area Fourmile Creek trail (774) and Saguache Creek trail (776) provide nonmotorized access through the area

Remoteness: This area is somewhat rugged with limited access which provides a certain degree of seclusion and remoteness.

Natural Integrity: The area's long-term ecological processes are intact and functioning. Some areas experienced fire 80-150 years ago

Apparent Naturalness: The majority of the area appears natural, with the exception of numerous primitive roads. The area is characterized by numerous canyons and tributaries of Saguache Creek. Vegetation is ponderosa pine in lower elevations, some lodgepole pine in mid-elevations, and spruce/fir at high elevations. This area is dissected by several major drainages which include Saguache Creek, California Gulch, Duckfoot Creek, Fourmile Creek and main Fork of Buck Park Creek

Manageability: Private and BLM land is adjacent to the eastern boundary. One inholding, owned by a grazing permittee, is in the center of the area. Given the rugged nature of this area, this area's natural character and recreation setting can be maintained

LOST PARK (0209A9)

Acres: 6,060

Access Routes: FDR 740 - Fourmile Creek road is adjacent to this area's western and a portion of its northern boundaries. Forest trail 756 - Luder's Creek which is nonmotorized is within the area

Remoteness: Because of the limited access, one can get a sense of solitude and seclusion within the area

Natural Integrity: The area's long-term ecological processes are intact and operating. The area has had natural fires occurrences some 80 - 100 years ago

Apparent Naturalness: The general landscape is natural in appearance. Vegetation is Ponderosa pine in the lower foothills, and Engelman spruce/subalpine fir at higher mountainous terrain. Luder's and Elk Creeks are the major drainages within the area.

Manageability: The area's natural character and recreation setting can be managed and maintained

ANTORA MEADOWS (0209B3)

Acres: 22,861 (Bear Creek and Antora Areas)

Access Routes

Bear Creek Area - This area has a primitive 4WD road, #860 (Indian Park), along its southwestern border. There are no roads or trails extending into the area.

Antora Meadows - A portion of a 4WD loop road (#880) passes through the southeast portion of this area. There is also a 4WD road (#880.2B - Antora Meadows), which extends 4 ½ miles to a private inholding in the area. There are also three foot and horseback FDTs within the area, #767 (East Middle Creek), #766 (Indian Creek), and #763 (Flagstaff Creek)

Remoteness

Bear Creek Area - There is some feeling of isolation within this area.

Antora Meadows - The northwest portion of this area gives one the feeling of seclusion, because of no access by motor vehicles. The south end, however, is adjacent to the Middle Creek road, which generates moderate traffic noise. The area near Antora Meadows is used a great deal during hunting season. The eastern portion is adjacent to a proposed timber sale. Portions of Antora Peak that are not accessible by vehicle traffic offer a feeling of seclusion and inaccessibility.

Natural Integrity

Bear Creek Area - For the majority of the area, long-term ecological processes are intact and operating. Exceptions occur along roads and the more heavily used trails. This area is separated from B1 by small timber sales and from B3 due to a natural gas pipeline constructed approximately 30 years ago.

Antora Meadows - In most of the area, long-term ecological processes are intact and functioning. Exceptions occur along roads and the more heavily used trails, near range improvements, and old homestead sites.

Apparent Naturalness

Bear Creek Area - The majority of the area appears natural. The area is characterized by drainages running through steep narrow canyons. Some mountain parks can be found in the area. Vegetation is ponderosa pine in lower elevations, some lodgepole pine in mid-elevations, and spruce/fir at high elevations.

Antora Meadows - The majority of the area appears natural, with the exception of patented mining claims within the area, and small-scale sawmills that operated in the late 1800's and early 1900's. The area is characterized by mostly north-south canyons; with some running west to east. Vegetation is bunchgrass/ponderosa pine in lower elevations, some lodgepole pine in mid-elevations, and spruce/fir at high elevations. There is some subalpine and alpine vegetation along the Continental Divide.

Manageability

Bear Creek Area - State, private, and BLM land adjoin the east and south boundaries. The major drainage is Bear Creek, with minor intermittent drainages to the north. A pipeline lies east of the area. The area is of average suitability roadless qualities. Possible problems to this approach are the easy road access along east and west boundaries, private lands and potential timber values.

Antora Meadows - This large area is bordered by private, BLM, San Isabel NF, and Gunnison NF lands. The eastern portion has a number of private inholdings from early mineral patents. Patents in the Antora Meadows area currently active. A pipeline is just west of the area. The western portion offers real opportunity for managing the area as roadless, owing to its pristine condition. The eastern portion, however, would be difficult to manage for roadless qualities, because it has a large number of private inholdings, is currently very popular with 4WD recreationists, is roaded by a loop trail and connectors, and may have further mineral activity in the future.

UTE PASS (0209B8)

Acres: 9,068

Access Routes: This area is bordered along its northwest side by #852 (Ute Pass), which is suitable for 4WD vehicles only. There is one FDT #845 (Coleman Cutoff), that passes through the eastern portion of this area.

Remoteness: This area has little seclusion in the western part, but the east end has only one trail passing through. Some feeling of seclusion and inaccessibility can be experienced here.

Natural Integrity: In most of the area, long-term ecological processes are intact and functioning. Exceptions occur along roads, near range improvements, and old homestead sites.

Apparent Naturalness: The majority of the area appears natural, with the exception of an electrical transmission line through the western corner; and past mining activity. The area is characterized by rugged portions of granite boulders. Vegetation is dry grassland/pinyon-juniper in lower elevations, ponderosa pine in mid-elevations, and spruce/fir intermixed with aspen at higher elevations.

Manageability: The Ute Pass area is surrounded by private and BLM land on the north, east, and south sides. There are two internal private inholdings in Schecker Gulch and Asterhouse Gulch. The Saguache Peak electronics site is also on the western edge of the area. The area is rugged, with steep and rocky slopes. The area could be managed as a primitive area. Best potential use is for wildlife winter range for deer and elk, and mountain lion habitat.

ELKHORN PEAK (0209B9)

Acres: 10,808

Access Routes This area has several FDTs passing through it; #923, #924, and #925. There are two 4WD roads that extend to the western edge of the area; #888 (Greenback Gulch) and #867 (Eagle Gulch). The Peterson Creek road borders the eastern portions of the area and the Kelly Creek road is inside the area, but is closed ½ mile above the Forest boundary.

Remoteness: A feeling of seclusion and inaccessibility can be experienced on the west end, in the rugged Elkhorn and Hayden Peaks area.

Natural Integrity: In most of the area, long-term ecological processes are intact and functioning. Several old roads were obliterated and reseeded in 1992.

Apparent Naturalness: The majority of the area appears natural. The area is steep, and bisected by a north-south ridge. Drainages run east and west. Vegetation is ponderosa pine in lower elevations, Douglas-fir in mid-elevations, and alpine associations at higher elevations. Aspen stands occur in areas burned in the past.

Manageability: This large area is bordered by private and BLM lands on both east and west sides. The west side includes the town of Bonanza and the Bonanza Historic Mining District. Several patented and unpatented mines occur within and adjacent to this area, but there is no known activity at present. Mining prospects are scattered throughout the area. The area's natural character and recreation setting can be maintained. Should mineral activity and discovery occur in the future, it will be difficult to maintain the area's natural character.

DORSEY CREEK (0209C2)

Acres: 4,435 (adjacent to the Sangre de Cristo Wilderness)

Access Routes: This area has two 4WD roads bordering its southern and western boundaries: FDR 990 - Dorsey Creek and FDR 991 - San Luis Creek. Simmons Creek trail (#757) passes through the eastern side of the area.

Remoteness: The western area is easily accessible with little sense of remoteness or seclusion. The eastern area is more remote with a better sense of remoteness and seclusion.

Natural Integrity: For the majority of the area, long-term ecological processes are intact and functioning.

Apparent Naturalness: The majority of the area appears natural, with the exception of past prospecting activities. The area is characterized by steep, open mountain slopes with drainages sloping to the west. Vegetation ranges from oakbrush in the lower elevations to Engelman spruce/subalpine fir with intermingled aspen in the higher elevations.

Manageability: Because of the area's past prospecting activities and easy access, its natural character could be difficult to maintain

BUTTERFLY (0209C3)

Acres: 2,695 (adjacent to the Sangre de Cristo Wilderness)

Access Routes: This area is bordered along its northwestern side by Forest Road 982 - Rock Creek. There are no Forest trails within the area

Remoteness: Given the area's rugged terrain, one can get a sense of remoteness and seclusion within the area

Natural Integrity: The area's long-term ecological processes are intact and operating

Apparent Naturalness: The majority of the area appears natural with the exception of numerous past prospecting sites. The area is characterized by steep, open mountainous slopes with drainages sloping to the west. Vegetation ranges from oakbrush in the lower foothills to Engelmann spruce/subalpine fir intermingled with aspen in the higher elevations.

Manageability: BLM land is adjacent to the area's western boundary. Patented mines are found in the vicinity of Rock Creek and prospect holes are common throughout the area. Most of the area's natural character and recreation setting can be maintained. Highest potential for the area is wildlife winter range and future mineral activity

MILLER CREEK (0209C4)

Acres: 1,202 (adjacent to the Sangre de Cristo Wilderness)

Access Routes: The closest road accessing this area is FDR 985. There are no Forest trails within the area

Remoteness: Because of the steep and rugged terrain, a feeling of remoteness and seclusion can be experienced.

Natural Integrity: The area's long-term ecological processes are intact and operating

Apparent Naturalness: The majority of the area appears natural with the exception of past prospecting sites. The area is characterized by steep, open mountainous slopes with drainages sloping to the west. Vegetation ranges from oakbrush in the lower foothills to Engelmann spruce/subalpine fir intermingled with aspen in the higher elevations

Manageability: Private and BLM lands are contiguous to this area's western boundary. Because of the rugged terrain and limited access, its natural character and recreation setting can be maintained

COTTON CREEK (0209C5)

Acres: 2,180 (adjacent to the Sangre de Cristo Wilderness)

Access Routes: County and BLM roads provide close access to this area. The area is bordered on the south by Forest trail #749 and Forest trail #963 passes through the middle of the area.

Remoteness: This area has very rugged terrain and limited access and provides a sense of remoteness and seclusion.

Natural Integrity: The area's long-term ecological processes are intact and operating.

Apparent Naturalness: The majority of the area appears natural with the exception of past prospecting sites. The area is characterized by steep, open mountainous slopes with westerly aspect. Vegetation is largely open hillsides of grassland and chaparral with Ponderosa pine.

Manageability: The area's natural character and recreation setting can be maintained.

CRESTONE (0209C6)

Acres: 8,145

Access Routes: This area is bordered on the south by road #949, suitable only for 4WD vehicles. There are numerous foot and horseback trails that pass through this area, including: #881, #858, #744, #860. There is also one 4WD road that extends ½ mile up Dimmick Gulch.

Remoteness: The lower (western) portion is easily accessible. The upper portion to the east is very rugged and steep. This particular area has a large number of visitors during summer and hunting season, but a feeling of seclusion and inaccessibility can be experienced in some portions of this area.

Natural Integrity: For the majority of the area, long-term ecological processes are intact and functioning. Exceptions occur along roads and the more heavily used trails, and near range improvements.

Apparent Naturalness: The majority of the area appears natural, with the exception of past prospecting activities, and associated human activities. There are small miner and trapper cabins scattered throughout the area. The area is steep and rugged. Vegetation ranges from oakbrush in lower elevations, to pinyon-juniper/chaparral mid-elevation, grading to alpine/subalpine associations at higher elevations. Aspen is intermingled throughout.

Manageability: Many private mineral patents and prospects are scattered throughout the area, left over from heavy mining activity around the turn of the century. One mineral patent owner is seeking roaded access to his parcel along the southern edge

POLE CREEK (0209C7)

Acres: 1,818 (adjacent to the Sangre de Cristo Wilderness)

Access Routes: The area's western boundary borders the Baca Grant and at the present time no public right-of-way is in place to cross the Grant. The area is relatively inaccessible from the north or south due to the steep and rugged terrain. Access to this area is mainly from the Pike/San Isabel side.

Remoteness: Since access is limited, a feeling of seclusion and remoteness can be experienced within the area.

Natural Integrity: The area's long-term ecological processes are intact and operating.

Apparent Naturalness: The majority of the area appears natural with the exception of past prospecting sites. Vegetation ranges from oakbrush in the foothills to pinyon-juniper and chaparral in the mid-elevation sites to Engelman spruce/subalpine fir stands with intermingled aspen in the higher elevations.

Manageability: The area's natural character and recreation setting can be maintained. Because no right-of-way exists to cross the Baca Grant, it is difficult to access this area for management purposes.

HOT SPRINGS (0209C8)

Acres: 488 (adjacent to the Sangre de Cristo Wilderness)

Access Routes: There is one Forest trail (#753) which borders this area along the north side.

Remoteness: Because of the limited access and rugged terrain, one can get a sense of seclusion and remoteness within the area.

Natural Integrity: The area's long-term ecological processes are intact and operating.

Apparent Naturalness: The area is natural in appearance. It is characterized by steep, open mountainous slopes with westerly aspect. Vegetation on the large open hillsides is grassland/chaparral with Ponderosa pine.

Manageability: The area's natural character and recreation setting can be maintained.

TROUT MOUNTAIN (0209DA)

Acres: 27,265

Access Routes: Roads within close proximity of this area are: U.S. Highway 160 (level 3) and FDR 430 - Shaw lake (level 2) on its south and west boundary. There are numerous nonmotorized FDTs and one motorized trail within the area.

Remoteness: Because of the area's size and nonmotorized recreation opportunities, one can obtain a sense of remoteness and seclusion when in this area.

Natural Integrity: The area's long-term ecological processes are intact and functioning. Portion of this area were cut for railroad ties, and minor evidence of the old logged-over areas and roads remains. Recovery of these areas is naturally occurring.

Apparent Naturalness: The general landscape is natural appearing. Along its eastern boundary it contains high, mountainous terrain with steep cliffs. Vegetation is mature Engelmann spruce/alpine fir interspersed with Douglas-fir and aspen.

Manageability: The area provides nonmotorized opportunities with a limited a limited motorized travel trail route. The area's primitive character and recreation setting can be maintained. There is a small parcel of private land (Metroz Lake area) within the area.

BEAVER MOUNTAIN (0209DE)

Acres: 9,036

Access Routes: General access roads within close proximity of this area are: U.S. Hwy .160 on its western boundary; FDR 360 - Beaver Creek (level 3) on its southern boundary, and FDR 350 - Willow Creek (level 3) on its eastern boundary. The area contains portions of two FDT motorized trails.

Remoteness: Because of the area's limited access and steep terrain, one can get a sense of seclusion and solitude.

Natural Integrity: The area's long-term ecological processes are intact and functioning. It had an extensive road system associated with the old railroad tie cutting activity. The area has rehabilitated itself and the old road systems are used as trails.

Apparent Naturalness: The area is natural in appearance. The area is characterized as high elevation, mountainous terrain with Engelmann spruce/fir stands. Numerous secondary streams are within this area.

Manageability: The area provides for some limited motorized opportunity and a large area of nonmotorized use. The area's primitive character and recreation settings can be maintained.

MIDDLE ALDER (0209DI)

Acres: 5,384

Access Routes Roads within close proximity of this area are FDR 610 - Alder (level 2) on its west boundary; FDR 611 - Difficult/Bear (level 2) on its northern boundary, and FDR 630 Agua Ramon (level 2) on its east boundary. There are three FDTs within this area providing motorized opportunities.

Remoteness: Because of the area's steep, rocky terrain, one can get a sense of seclusion within the area.

Natural Integrity: The area's long-term ecological processes are intact and functioning.

Apparent Naturalness: The area is natural in appearance. This area is characterized by steep, mountainous terrain comprised of Engelmann spruce/alpine fir stands. Three major drainages (Middle Alder, West Bear, and Bear Creek) are within this area.

Manageability: The area provides both motorized and nonmotorized recreation opportunities. Its primitive character and recreation settings can be maintained.

WIGHTMAN FORK / BLOWOUT PASS/ UPPER BURRO (0209M1)

Acres: 7,185

Access Routes: Roads which provide general access to this area are: FDR 250 - Alamosa-Conejos River Road (level 3) which borders the area's southern boundary; FDR 328 - Spring Creek Road (level 2) along its eastern boundary and FDR 334 - Bolita (level 2) accessing a portion of the area's northern boundary. A two mile stretch of Forest trail 700 (Dry Creek - Motorized) is situated within the area.

Remoteness: With the limited access, one can obtain a sense of seclusion and solitude when in this area.

Natural Integrity: The area's ecological processes are functioning and intact. Portions of three grazing allotments are within the area.

Apparent Naturalness: The area's landscape is natural appearing with minimal human disturbance. The upper Burro area is characterized by high elevation mountainous terrain with Engelmann spruce/subalpine fir stands dissected by tributaries draining into Burro Creek. Wightman Fork/Blowout area is characterized by steep side canyons of Engelmann spruce/subalpine fir stands intermingled with aspen and bristlecone pine stands. Numerous rugged and steep tributaries are within the area which feed into the Alamosa River.

Manageability: The area provides nonmotorized opportunities. Activities include fishing and hunting. The area's primitive character and nonmotorized setting can be maintained.

BENNETT MOUNTAIN/ BLOWOUT PASS-WILLOW CREEK / LION PNT - GREENIE MTN. (0209M2)

Acres. 52,882

Access Routes: General access to this large area are

Bennett Mtn FDR 330 - Pinos Creek road (level 3); FDR 328 - Burro Creek road (level 2), FDR 267 - Bonafacio road (level 2) which border the area's eastern boundary and FDR 320 - Frisco Creek road (level 3) on its northern boundary. There are extensive Forest trails within this area available to motorized and nonmotorized users.

Blowout Pass-Willow Creek FDR 280 - Spring Creek road (level 2) is adjacent to the area's eastern boundary and FDR 237 - Willow Creek road (level 2), FDR 250 - Alamosa-Conejos River road (level 3) is along the area's southern boundary and FDR 271 - Cat Creek road (level 2) is near the area's north and east boundary. There are numerous Forest trails open to both motorized and nonmotorized users.

Lion Pnt-Greenie Mountain: FDR 271 - Cat Creek road (level 2) and FDR 271.2B - Deer Creek road (level 2) and FDR 236 - Cat Creek Park road (level 2) provide access near this area. There are no inventoried Forest trails within this area.

Remoteness: Because of the area's size and once away from the existing trails, one can get a sense of seclusion.

Natural Integrity: The area's long term ecological processes are intact and functioning. There is evidence of past early century logging and historic fire occurrence.

Apparent Naturalness: This area is natural appearing. The area traverses from low-elevation terrain (foothills) with pinyon-juniper and Ponderosa pine stands -- to mid-elevation mountainous terrain comprised of Douglas-fir and aspen stands -- to high-elevation Engelmann spruce/fir stands interspersed with aspen. Several major drainages are within the area.

Manageability: Bennett Mtn. - This area is natural appearing. The area traverses from low-elevation terrain (foothills) with pinyon-juniper and Ponderosa pine stands -- to mid-elevation mountainous terrain comprised of Douglas-fir and aspen stands -- to high-elevation Engelmann spruce/fir stands interspersed with aspen. Several major drainages are within the area.

Blowout Pass-Willow Creek - The area's landscape is undisturbed. The area is comprised of numerous steep-sided drainages with Engelmann spruce/subalpine fir stands with intermingled aspen stands.

Lion Pnt-Greenie Mtn. - The area is natural appearing. The area is comprised of low-elevation terrain with pinyon-juniper stands and several deep canyons emanating from Greenie Mountain. The upper-elevation of Green Ridge and Lion Point is Engelmann spruce/subalpine fir stands interspersed with aspen.

DEEP CREEK / BOOT MOUNTAIN (0209M3)

Acres: 28,904

Access Routes:

Deep Creek - This area is bordered on the north and west by road #675, which is a level 2 road. Road #787, a 4WD primitive road, extends into the area from the west for 1 ½ miles to reach a private inholding (Sky City). The La Garita Stock Driveway borders the east side of the area and is now a part of an ATV-designated trail system.

Boot Mountain - General road access within close proximity of this area are FDR 650 - Baughman Creek road (level 2), FDR 673 - Cave Creek road (level 2) and FDR 676 - Bowers Creek road (level 2). There are numerous Forest trails within the area providing motorized opportunities.

Remoteness:

Deep Creek - This very large area has few trails through it and provides a sense of seclusion and remoteness.

Boot Mountain - Because of the available access to the area and motorized trails, one does not get a sense of remoteness or seclusion.

Natural Integrity:

Deep Creek - In most of the area, long-term ecological processes are intact and operating. Exceptions occur along roads and the more heavily used trails, and near range improvements. The area had extensive natural fires approximately 100 years ago.

Boot Mountain - The area's long-term ecological processes are intact and operating. Evidence of Fremont's expedition camps are located within this area.

Apparent Naturalness:

Deep Creek - With the exception of the Sky City Mining District, the majority of the area appears natural. Numerous drainages run to the north. The area is characterized by deep narrow canyons, steep slopes and alpine plateaus. Vegetation is primarily spruce/fir, with inclusions of aspen, subalpine and alpine associations.

Boot Mountain - The area is natural in appearance. This is a high, mountainous terrain area with mature and pole-sized Engelmann spruce/subalpine fir stands with interspersed open parks.

Manageability:

Deep Creek - This large area is irregularly shaped, in somewhat of a north-south trending V-shape, with the left V-leg very large and the right V-leg, very much smaller and connected by a narrow strip. It is dissected by four major drainages: Wannamaker, Bear, Deep, and Johns Creeks. The Sky City Mining District, a large multiple-owner inholding, is accessed by a primitive road along Wannamaker Creek from Saguache Creek. Public access further up Wannamaker Creek is blocked with a locked gate. A pack trail continues beyond the private land up Wannamaker Creek and connects with the La Garita Stock Driveway (ATV route).

The area presents some contradictions in terms of managing it for roadless character on one hand, much of the terrain is steep and inaccessible, the large private inholding, motorized ATV use along the La Garita Stock driveway (which presents management problems of ingress by ATV users), and potential for timber activity north of Bowers Peak conflicts with managing the area for its roadless values

Boot Mountain - This area provides motorized recreation opportunities. Its natural character and recreation setting can be maintained

SPECTACLE LAKE (0209P1)

Acres: 822 (adjacent to the South San Juan Wilderness)

Access Route: Access to this area is from FDR 250 - Conejos River Road (level 3) which parallels its eastern boundary. There are no system trails in the area.

Remoteness: Because of its close proximity to FDR 250 (sight and sound) and its small size, one does not get a sense of remoteness or seclusion.

Natural Integrity: The area's natural ecological processes are intact. The area's riparian area could be altered by grazing and heavy use from anglers who fish in this area.

Apparent Naturalness: The area's landscape appears natural. This area is mainly river bottom with blue spruce, cottonwoods, and riparian. The Conejos River runs the entire length of the area.

Manageability: The area provides nonmotorized opportunities. The main recreational activity is fishing. The area's primitive character and nonmotorized setting can be maintained.

SULFUR TUNNEL (0209RA)

Acres: 1,859 (adjacent to the Weminuche Wilderness)

Access Routes: Access to this area is by FDR 524 - Copper Creek road (level 2). There is a special use road accessing the private inholding at Sulfur tunnel. There are a couple Forest trails within the area available for nonmotorized recreation use.

Remoteness: Some sense of remoteness and solitude can be obtained within this area.

Natural Integrity: The area's ecological processes are functioning and intact. Vehicle access is permitted by special use permit to the private inholding.

Apparent Naturalness: The area is characterized by gentle to steep mountainous slopes with Engelman spruce/subalpine fir stands and Rocky Mountain whortleberry. Trout Creek is the major drainage within the area.

Manageability: With the exception of the private inholding and access road, the area's natural character and recreation setting can be maintained

INDIAN RIDGE (0209RE)

Acres: 1,609 (adjacent to the Weminuche Wilderness)

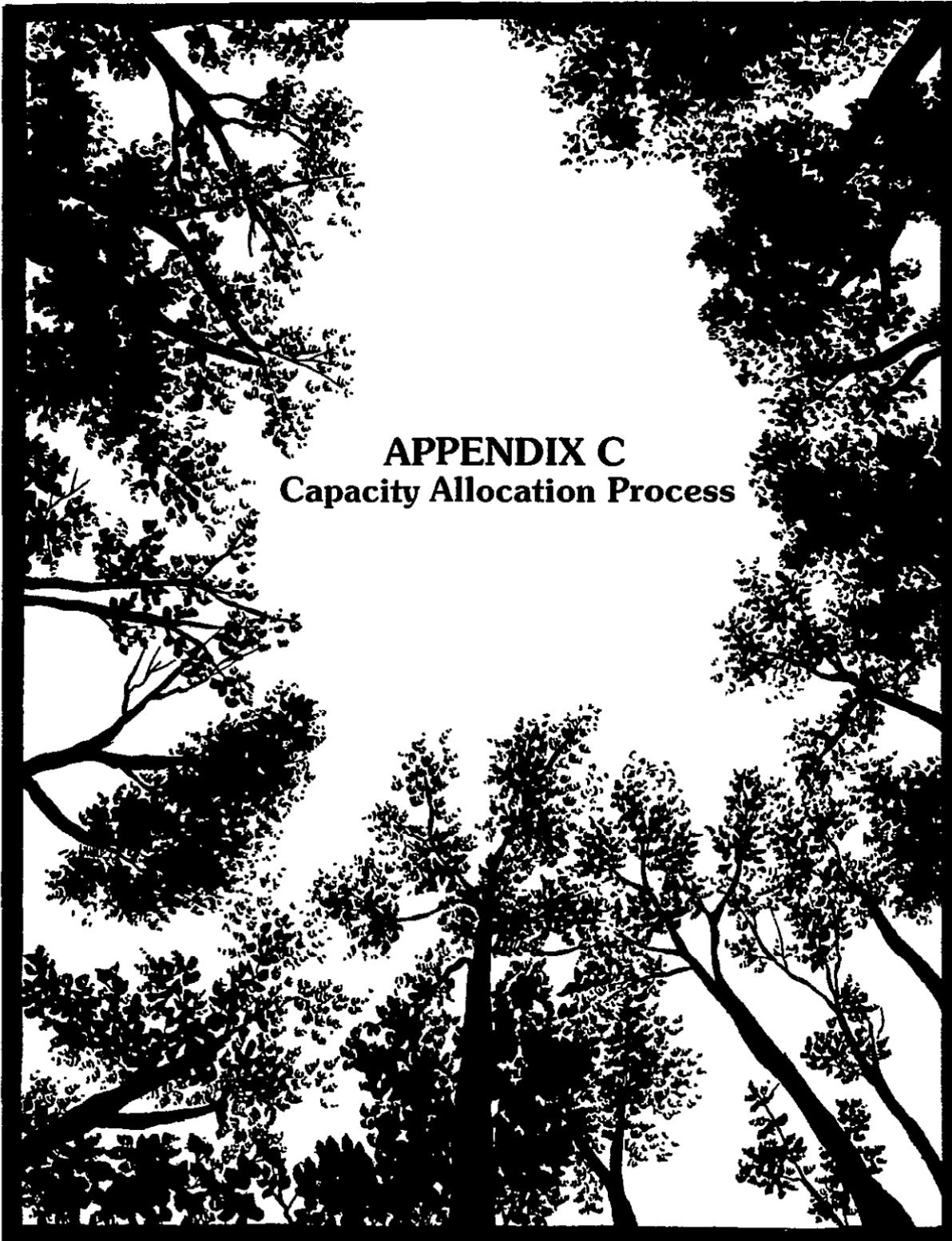
Access Routes: This area is accessed via FDR 520 - Rio Grande road (level 3 and level 2) and FDR 506 - Beartown road (level 2). Forest trail 787 is within the southeastern part of the area

Remoteness: Because of the steep terrain and limited access, one can get a sense of seclusion and remoteness within the area

Natural Integrity: The area's long-term ecological processes are intact and functioning

Apparent Naturalness: This area is characterized by west facing, steep alpine and mountainous slopes and valley bottom. The mountainous slopes have Engelman spruce/subalpine fir stands with Rocky Mountain whortleberry. Willows and sedges are in the valley bottom

Manageability: The area's natural character and recreation setting can be maintained



APPENDIX C
Capacity Allocation Process

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Capacity Allocation Process

PURPOSE

The purpose of the capacity determination process is to establish potential service days. These potential service days will assist in the process of determining the amount of service days which may be authorized for commercial, institutional and public users on the Rio Grande National Forest.

CRITERIA

Because a majority of the dispersed recreation use on the Forest is associated with road and trail travelways, the capacity determination calculations are based upon recreation settings and people at one time (PAOT) per road or trail mile or both.

The capacity allocation process is divided into two phases. The first phase establishes the framework for calculating potential service days. Factors used in establishing the service day calculations are: 5th-level watersheds, recreation settings, People at one time (PAOT) per trail/road mile and associated limiting factors. Limiting factor criteria are:

- (a) available terrain (20% slope or less) where user activity occurs
- (b) Frissell/Cole condition of available campgrounds
- (c) riparian/wetland areas
- (d) campsite distance from water/trail/road and/or vegetative screening, and
- (e) critical wildlife areas or plant and animal TES areas

Criteria associated with the Recreation Opportunity Spectrum (ROS - Defines the recreation setting) are as follows:

A. People at One Time per Mile of Trail

ROS Setting	PAOTs / Trail Mile	
	Very Low	Low
1 Primitive (Wilderness)	0.5	1.0
2 Semi-primitive nonmotorized	2.0	3.0
3 Semi-primitive motorized	2.0	3.0
4 Modified roaded	2.0	3.0

The second step in the process takes the service day calculations and based on the season of use (summer, fall, winter) determines the total amount of service days and allocates the amount of service days for commercial, institutional and public users. The allocation for commercial is 35%, institutional is 10% and noncommercial is 55%.

Example:

Watershed	Miner's Crk Composite
Setting	Semi-primitive
Calculation	24m x 3=72
Summer	72 x 93=6700
Fall	72 x 82= 5900

Allocation:

Summer	6700	Fall	5900
Commercial	2350		2160
Institutional	670		590
Public	3680		3210

This process ties service days to specific watersheds (areas). Unless service days are requested and approved for specific areas, use of permitted days in other watersheds (areas) is not authorized or allowed.

Service days which are available for future services (new permits) on the Forest will be announced via a prospectus and awarded to the best qualified applicant. The prospectus will identify the amount of available service days, watersheds where service days are available, required information needed with the application submittal and the selection criteria.

RIVER DETERMINATION PROCESS:

- a. The following example describes the process by which Service Days are calculated for the upper Rio Grande River (from the Rio Grande Box south to the 4UR Ranch entrance). Approximately 4 ½ miles of National Forest System lands are situated within this 31 mile stretch of river.

Service day calculations: number of people per raft (avg. of 5) x number of trips per day (1 all day trip & 2 half day trips) x use season equals number of Available Service Days. This formula equates to 3 groups of 2 commercial rafts on the upper river section at one time. Calculation: $5 \times 6 \times 91 = 2,730$ Available Service Days.

The upper river Permitted Service Days is: 65% for outfitter and guides (1,775 PSD) and 35% for public use (955 service days). This allocation is based on the large percentage of private land within this stretch of river and the limited river access points (put in - take out).

- b. The following example describes the process by which Service Days were calculated for the lower stretch of the Rio Grande River from the 4UR Ranch

entrance, south to Collier State Wildlife Area. A majority (90%) of this 6 ½-mile section of river is located on National Forest System lands.

Service day calculations. Number of people per rafts (avg. of 5) x number of trips per day (2 half-day trips in morning and 2 half-day trips in the afternoon or 2 all-day trips per day) x length of season equals number of Available Service Days.

1,700 service days (65%) are currently allocated for commercial use along this stretch of river (priority and temporary permits) and approximately 1,000 service days (35%) are allotted for public use.

The intent is to not degrade the overall experience that the recreation visitor is seeking.

There is a consensus from private land owners (comments received) along the river that the Forest Service should not provide the same experience level on the Rio Grande River that is currently allocated on the Arkansas River.

These calculations take into account both the private and public users including an optimum level of bank fishing privacy. On average, there will be occasions when river use will only be 1 or 2 trips in a day while at other times (heavy use periods) river use will account for 6 or more rafts on the river per day. When the average daily use (trips or encounters) exceeds capacity on 18 days (20% of the use season days) or more days within a normal season, additional action (permitting public users or reducing commercial user days) will be required in order to maintain a high quality experience.

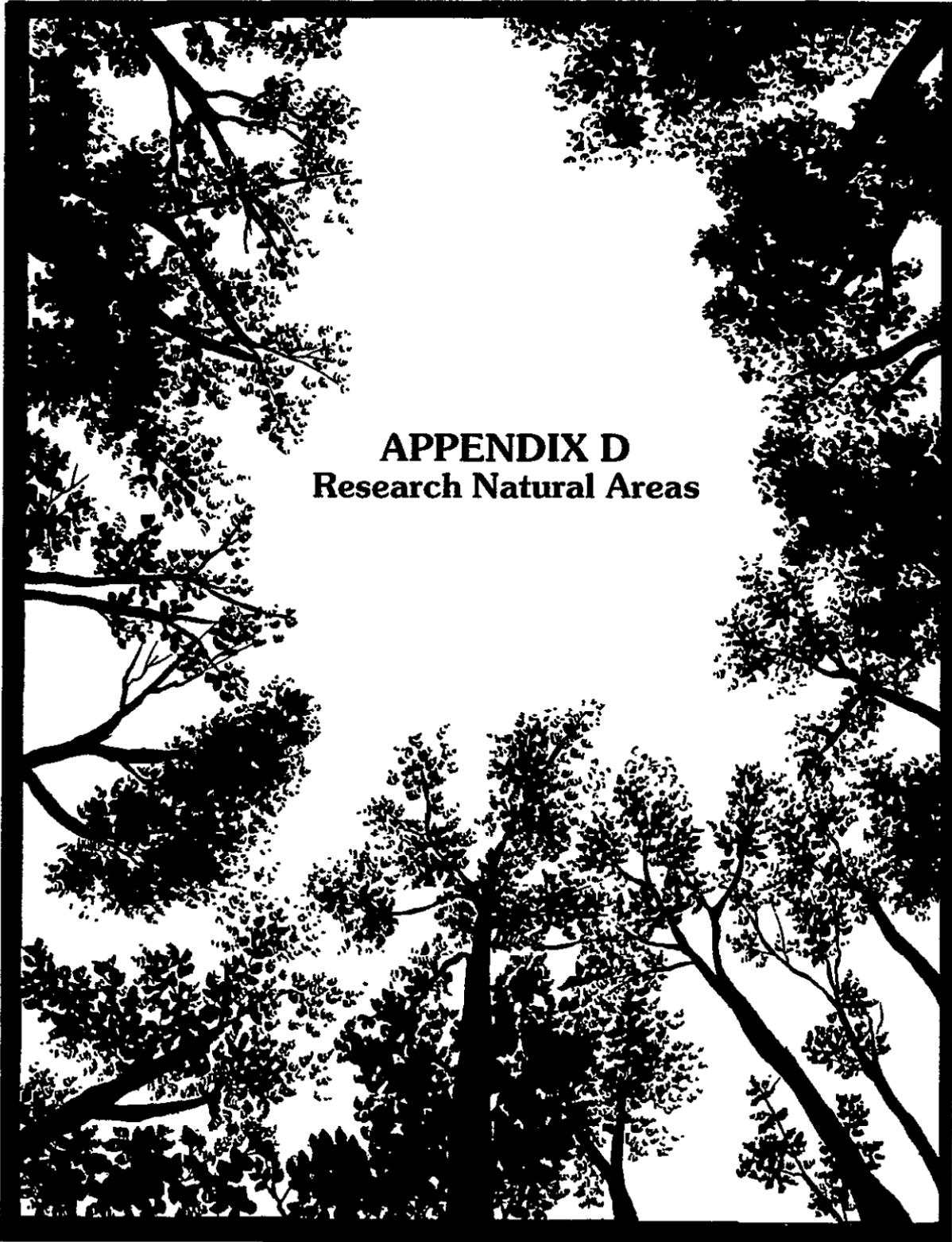
No attempt will be made to regulate where O&G's enter or egress from the river and/or time the frequency between rafts entering the river. Should conflicts arise appropriate regulatory actions will be implemented.

Watershed Number W (Wilderness)		Summer				Fall			
		Service Days	Commercial	Institutional	Noncomm.	Service Days	Commercial	Institutional	Noncomm.
1301000101	Ute composite/Quartzite Upper Rio Grande W Weminuche Crk	2400 11700 335	840 4100 100	240 1200	1320 6400 235	2400 10300 340	960 3600 102	240 1030	1200 5670 238
1301000102	Upper N Clear Crk Upper Spring Crk South Clear Crk	5200 4100 3700	1800 1440 1300	600 410 370	2800 2250 2030	4600 3600 3300	1600 1260 1150	500 360 330	2500 1980 1820
1301000103	W Squaw Ck/Texas Ck Road Canyon	1200 5600	420 1960	120 560	660 3080	1200 4900	420 1700	120 500	660 2700
1301000104	W Trout Crk	2700	950	300	1450	2700	950	300	1450
1301000105	Middle Crk W Ivy Crk	4500 600	1580 210	450 60	2470 330	3900 600	1370 210	400 60	2130 330
1301000106	Middle Rio Grande Farmer's Crk	9200 5000	3220 1750	920 500	5060 2750	8100 4400	2840 1540	810 440	4450 2420
1301000107	Miners Crk	6700	2350	670	3680	5900	2100	590	3210
1301000108	West/East Willow Crk	5000	1750	500	2750	4400	1540	440	2420
1301000109	W West Bellows Crk East Bellows Crk	1800 3000	630 1050	180 300	990 1650	1800 2600	630 910	180 260	990 1430
1301000110	W Upper Goose Crk Lower Goose crk	2400 4500	840 1580	240 450	1320 2470	2400 4000	960 1400	240 400	1200 2200
1301000111	Blue Crk/elk Crk	6700	2350	670	3680	5900	2070	590	3240
1301000112	West Alder Crk	9800	3430	980	5390	8600	3010	860	4730
1301000113	Upper south Fk Rio Grnd Trout Crk Park Crk/Pass Crk Beaver Crk	6400 7500 5600 9800	2240 2630 1960 3430	640 750 560 980	3520 4120 3080 5390	6000 6700 4900 8600	2100 2350 1700 3010	600 670 490 860	3300 3680 2710 4730
1301000114	Embargo Crk	7500	2630	750	4120	6700	2350	670	3680
1301000115	Bear Crk Willow Crk/Wolf Crk	5600 7300	1960 2560	560 730	3080 4010	4900 6400	1700 2240	500 640	2700 3520

Watershed Number		Summer				Fall			
		Service Days	Commercial	Institutional	Noncomm	Service Days	Commercial	Institutional	Noncomm
1301000201	Old Woman's Crk Schrader Crk	7000 2800	2450 980	700 280	3850 1540	6100 2500	2140 880	610 250	3350 1370
1301000202	Pinos Crk	9800	3430	980	5390	8600	3010	860	4730
1301000203	San Francisco Crk	9800	3430	980	5390	8600	3010	860	4730
1301000204	S Frk Rock Crk Cat crk	7000 8400	2450 2940	700 840	3850 4620	6100 7400	2140 2600	610 740	3350 4060
1301000205	Upper Alamosa Rvr Lower Alamosa Rvr	9800 8400	3430 2940	980 840	5390 4620	8600 7400	3010 2600	860 740	4730 4060
1301000206	Hot Crk	5600	1960	560	3080	4900	1700	490	2710
1301000207	La Jara Crk	6100	2140	610	3350	5400	1900	540	2960
1301000301	W Clover Crk/Alder Crk Dorsey Crk/Decker Crk	5000 1400	1750 490	500 140	2750 770	4400 1200	1540 420	440 120	2420 660
1301000302	Central & South Kerber North Kerber Crk	11200 5600	3920 1960	1120 560	6160 3080	9900 4900	3470 1700	990 490	5440 2710
1301000303	W Turquoise Crk/Peterson Butterfly Crk	2800 1800	980 630	280 180	1540 990	2500 1800	880 630	250 180	1370 990
1301000304	W Black Canyon	1400	490	140	770	1400	490	104	770
1301000305	W (1) Garner Crk/Major Crk W (2) Cotton Crk W (3) Wild Cherry Crk W (4) Rito Alto Crk	1000 700 400 1000	350 250 140 350	100 70 40 100	550 380 220 550	1000 700 400 1000	350 250 140 350	100 70 40 100	550 380 220 550
1301000306	W (1) San Isabel Ck W (2) N Crestone Ck W (3) S Crestone/Willow Ck W (4) Cottonwood Ck	800 1000 800 1000	280 350 280 350	80 100 80 100	440 550 440 550	800 1000 800 1000	280 350 280 350	80 100 80 100	440 550 440 550
1301000307	W Sand Ck W Medano Ck - W HorseCyn/Mosca Crk/Tell W Zapata Crk	1400 1200 1000 1000	490 420 350 350	140 120 100 100	770 660 550 550	1400 1200 1000 1000	490 420 350 350	140 120 100 100	770 660 550 550

Watershed Number		Summer				Fall			
		Service Days	Commercial	Institutional	Noncomm	Service Days	Commercial	Institutional	Noncomm
1301000308	Holbrook Crk	2800	980	280	1540	2500	880	250	1370
1301000401	Saguache Park	14000	4900	1400	7700	12300	4300	1230	6770
W	Middle Fork	3000	1050	300	1650	2800	980	280	1540
W	South Fork	1400	490	140	770	1400	490	140	770
W	Whale Ck	700	250	70	380	700	250	70	380
	Wannamaker/Deep Crk	5000	1750	500	2750	4400	1540	440	2420
1301000402	John's/Allen/Saguache Crks	8400	2940	840	4620	7400	2600	740	4060
	Luder's /Fourmile Crk	7500	2630	750	4120	6600	2310	660	3630
1301000403	Hat Spring Crk	4700	1650	470	2580	4100	1440	410	2250
1301000404	Taylor Canyon	4200	1470	420	2310	3700	1300	370	2030
	Sheep Ck	11200	3920	1120	6160	9900	3470	990	5440
1301000405	Houselog/Mill Ck	9800	3430	980	5390	8600	3010	860	4730
1301000406	Sargent Mesa	5600	1960	560	3080	4900	1700	500	2700
1301000407	Middle Ck	4700	1650	470	2580	4100	1440	410	2250
1301000408	(1)Ford/Findley Crk	4200	1470	420	2310	3700	1300	370	2030
	(2) Tracy/San Juan Crk	2800	980	280	1540	2500	880	250	1370
1301000409	Middle Frk Carnero Crk	8400	2940	840	4620	7400	2600	740	4060
	South Frk Carnero Crk	7000	2450	700	3850	6200	2170	620	3410
1301000410	La Garita Crk	8400	2940	840	4620	7400	2600	740	4060
1301000411	English Valley	9800	3430	980	5390	8600	3010	860	4730
1301000501	Upper Conejos Rvr Comp	2000	700	200	1100	2000	700	200	1100
	Upper Conejos Rvr	9800	3430	980	5390	7400	2600	740	4060
1301000502	S Fork Conejos River	2700	950	270	1480	2700	950	270	1480
1301000503	Elk Ck	2000	700	200	1100	2000	700	200	1100
	La Manga Crk	3000	1050	300	1650	2500	880	250	1370
1301000504	Fox Crk	4200	1470	420	2310	3700	1300	370	2030
1301000505	Rio de los Pinos	7000	2450	700	3850	6200	2140	610	3350

Watershed Number		Summer				Fall			
		Service Days	Commercial	Institutional	Noncomm	Service Days	Commercial	Institutional	Noncomm
1301000506	Alverjones/Hourglass	1000	350	100	550	1000	350	100	550
	Conejos River	2800	980	280	1540	2500	880	250	1370
	Sheep Crk/Bear Crk	1900	670	190	1040	1700	600	170	930
	Rito Hondo/Bighorn Crk	8400	2940	840	4620	7400	2600	740	4060
1302010201	Rio Chama	5600	1960	560	3080	4900	1700	500	2700
1302010202	Wolf Ck	2800	980	280	1540	2500	880	250	1370



APPENDIX D
Research Natural Areas

APPENDIX D

Research Natural Areas

INTRODUCTION

This appendix explains the Research Natural Area program and answers questions that may arise during the Forest Plan Revision process

One of the keystones of ecosystem management is called "adaptive" management. Adaptive management recognizes that management decisions need to be made, even though the knowledge needed for making these decisions and their consequences is incomplete or uncertain. Under adaptive management, managers decide the best course with the available information, but monitor to ensure that the original decision had the desired effect. Research Natural Areas (RNAs) are key components of adaptive management, because they represent ecosystems in a natural condition. RNAs serve as reference areas to allow managers to assess the consequences of management on other similar areas. RNAs are also used by scientists to understand how ecosystems function, and are important for conserving biodiversity.

The first Forest Service RNA was established in 1927 on the Coronado National Forest in Arizona. Since then, the RNA system has grown to over 300 established RNAs nationwide with an additional 300 or more proposed for establishment. Forest Plans will propose additions to the RNA network, because of the essential role of RNAs in ecosystem management, and because the ecosystem types in the Rocky Mountain Region are poorly represented. Currently, there are only 10 RNAs in Colorado.

What RNAs Represent

The goal of the RNA program is to represent the ecological diversity that occurs on National Forests and National Grasslands so that we can assess the impacts of management and conserve biodiversity. An ecosystem can roughly be defined as the plants, animals, and environment of a given area. Some major ecosystem types that help define this ecological diversity on the Rio Grande National Forest include spruce/fir, aspen and ponderosa pine forests, shrublands, grasslands, alpine, and aquatic and riparian (streamside) ecosystems. At a finer scale, ecosystem types can be defined by several of their dominant plant species, such as the ponderosa pine/Arizona fescue and gambel oak/mountain mahogany types. At this level, ecosystem types are called plant associations or community types. Over 500 plant associations and community types have been identified on National Forests and Grasslands within the Rocky Mountain Region, and few of these are represented in RNAs.

Broad geographical differences in ecosystems are also recognized by performing RNA targeting of different ecosystem types within each Ecoregion Section (see Hierarchy of Ecological Units in Chapter Three). Variations in geology, soils, landforms, and climate

influence the kinds of plants and animals that live in different regions and can also be used as features for establishing a representative RNA system. The igneous and metamorphic rocks of the Sangre de Cristo Mountains and the volcanic rocks of the eastern San Juan Mountains are typical of the kind of significant ecological differences that the RNA system can try to represent. RNAs can also be used to provide extra protection for populations of Threatened and Endangered and Sensitive species.

Function of RNAs

RNAs serve at least three important functions for the Forest Service:

1. **Reference Areas:** RNAs serve as benchmarks or reference areas for monitoring and evaluating the sustainability and impacts of land management practices on lands with similar ecosystem types. To determine the impact of management on a specific area, it is desirable to have a similar area maintained in natural condition for comparison. By serving as a representative system of controls for land managers, RNAs make one of their most important contributions to ecosystem management.
2. **Biodiversity:** RNAs provide protection for biodiversity. A representative RNA system provides some degree of assurance that a wide array of plant and animal species are being given a high degree of protection for the future. This protection may be most important for the forms of biodiversity that ecosystems often depend upon the most and about which we know the least, such as soil microorganisms, fungi, and insects. RNAs can also be selected to provide a high degree of protection to specific populations of Threatened and Endangered and Sensitive species.
3. **Research:** RNAs provide sites for research into how ecosystems function. This research is often best accomplished in areas, such as RNAs, where ecological and evolutionary processes are functioning as naturally as possible. RNAs serve as sites for monitoring long-term change in ecosystems, including global climate change and shifting patterns in the landscape resulting from natural disturbances such as fire, floods, and insect epidemics. When scientists perform a variety of research projects in an identified area, such as an RNA, the cumulative results can greatly increase our understanding of particular ecosystems. One of the meanings of ecosystem management is that lands will be managed with the best information available; over the years, scientific research has helped provide that information. RNAs also serve an important educational role by providing excellent examples of ecosystems in relatively natural condition with functioning ecological processes.

Research Natural Areas help the Forest Service maintain the long-term health, productivity, and diversity of lands entrusted to its management by the public.

Condition of RNAs

Because RNAs represent ecosystems in their natural condition, RNAs should be located in areas with a minimum amount of impact from human use. RNAs should also contain good examples of the ecosystem types they represent. For some ecosystem types, no areas could be found without significant human impact. In these cases, RNAs are selected from the best

condition sites available. On the Rio Grande National Forest a concerted effort was made to select sites as potential RNAs that would have minimal conflicts with existing public uses of National Forest land. Therefore potential RNAs were primarily selected from lands that are roadless and in vacant or closed grazing allotments.

Size of RNAs

To serve as benchmarks, to conserve biodiversity, and to serve as research areas, RNAs must be large enough to maintain the natural processes that sustain ecosystems. For example, many of our forest, grassland and shrubland ecosystems evolved with fire as an important natural process. Fire and other natural disturbances produce a landscape that is a mosaic of patches of various sizes and ages since last disturbance (successional stages). These patches can vary from tens to thousands of acres in size. To maintain ecological processes in many of our fire dependent ecosystems, we prefer land areas several thousand or more acres in size to incorporate a mosaic of successional stages or to allow for their development in the future. Current ideas in conservation biology also recognize the potentially harmful influence of some outside land uses on the ecological integrity of small natural areas. Small natural areas may degrade easily and suffer species loss.

Larger natural areas also provide greater representation for the range of natural variability that occurs in most ecosystem types and makes RNAs potentially more valuable as benchmarks or controls for ecosystem management. Many questions about managing National Forests concern landscape patterns and processes. Some RNAs that represent these patterns and processes are desirable. Where possible, complete watersheds have been selected for potential RNAs, partially to maintain intact and naturally functioning aquatic and riparian ecosystems.

Management of RNAs

The Management-area Prescription provides an outline for how RNAs will be managed. The intent of RNA management is to minimize human impacts that will affect the ecosystem and to maintain biodiversity and natural processes. Therefore most potential RNAs were selected from areas that are roadless, in vacant or closed grazing allotments, in areas that have not experienced timber harvesting, and in areas that were not the highest use recreational areas on the National Forest. Road building and timber harvesting are not compatible uses for RNAs. Some degree of livestock grazing can be used to maintain grassland ecosystems found on National Grasslands, but livestock grazing is not a compatible use within RNAs on the Rio Grande National Forest, where native ungulates (elk, deer, and bighorn sheep) maintain healthy populations.

Recreational Management

Most of the potential RNAs on the Rio Grande National Forest were selected in areas that do not receive heavy recreational use. However, it is inevitable that varying degrees of recreational use will occur in all these areas. As human populations grow, recreational use will likely increase. Because RNAs serve as baselines or benchmarks and heavy recreational use can alter species populations and affect ecosystem function, recreational use is not encouraged (but not prohibited) in RNAs. For example, use of existing trails in RNAs is allowed, but no new trails will be constructed unless necessary to correct resource damage.

from existing trails Existing recreational trails often provide desirable access to RNAs for research, administrative, and educational purposes

In general, recreational standards for Wilderness are applicable to RNAs. Because of the desire to select minimally impacted areas that are excellent representations of ecosystem types, some RNAs are selected from within Wilderness areas. Large RNAs are valuable because they represent a large range of ecosystem conditions. Because existing wilderness-compatible recreation occurs in most large areas and because this recreation currently has an insignificant impact on ecosystem function in the proposed RNAs, no restrictions will be placed on current hiker, backpacker, outfitter-guide, horseback, hunting and fishing use. In certain instances some of these uses have value from a natural areas perspective, because through hunting they provide more natural regulation of elk, deer, and other ungulate populations by helping to replace extirpated predators. Outfitter and guide use will continue to be allowed, subject to possible changes arising from future carrying capacity analysis. For larger RNAs, where the impacts of nonmotorized recreation are primarily confined to narrow trail corridors, significant areas of land within the RNA will be essentially free of impacts. Larger RNAs also have the advantage of providing more flexibility in accommodating recreation use

National Forest travel management plans have identified some parts of the National Forest as restricted to nonmotorized use. This is as appropriate for RNAs as it is for Wilderness However, to accommodate some existing motorized and mechanized uses on certain highly desirable RNAs not in Wilderness, exceptions may be made in the Management-area Prescription. These are site-specific decisions made by the Forest Service, based on environmental issues, level of existing use, and public concern. An example of this on the RGNF is the proposed Spring Branch RNA where the established practice of ATV use for game retrieval during hunting season is proposed for continuance under Alternative B

Other aspects of recreational management in Wilderness are also appropriate to RNAs For Wilderness management a Limits of Acceptable Change process is available for monitoring and evaluating the impacts of increased recreational use on the Wilderness resource Sometimes where recreational impacts in Wilderness have increased above an acceptable level, methods to lessen these impacts have been implemented, such as placing restrictions on camping near water sources or establishing a permitting system This process of monitoring and evaluating recreational impacts is also desirable for RNA management. For newly established RNAs, existing levels of recreational use will be allowed unless specific restrictions have been identified in the Management-area Prescription Existing permits with commercial recreation providers such as outfitters and guides will continue to be honored, subject to the normal permit review processes that apply to all National Forest System lands

Fire Management:

Natural fire frequencies are desirable on RNAs However, excessive buildup of fuels from decades of fire suppression, valuable resources outside RNA boundaries, and special old growth or other values inside some RNAs may preclude allowing some natural fires to burn Site-specific fire management plans may need to be developed for some RNAs to identify circumstances in which natural fires can be allowed to burn freely and to design specific management-ignited prescribed fires to mimic natural fires

Exotic Species Management

Exotic (non-native) species are not desirable on RNAs. Some particularly invasive and unpalatable plant species, such as knapweed and Canada thistle, would be good targets for control in RNAs and elsewhere on public and private lands. However, some non-native weedy plant species, such as Kentucky bluegrass and cheatgrass, have become almost naturalized into many western landscapes and may be prohibitively expensive or almost impossible to eradicate. Decisions on the threats of exotic plant species to RNA values and possible control techniques, including the potential use of herbicides, will need to be made on a site-specific basis. The Colorado Division of Wildlife has introduced into parts of Colorado some game species such as mountain goats, which are found further north in the Rocky Mountains but are not known to be native to Colorado. The presence of these species is not desirable in an RNA, however, their presence may be inevitable in some areas that would be very valuable additions to the RNA system.

As with the management of all public lands, the management of RNAs should be based on a firm scientific basis with concern for long-term sustainability, ecological values, and public uses. These are some central tenets of ecosystem management. Research Natural Areas are an important natural legacy for the future and need to be managed accordingly.

DESCRIPTIONS OF PROPOSED RNAs ON THE RGNF

Deadman Creek Proposed RNA

This 4,777 acre area is located on the Saguache Ranger District on the western side of the Sangre de Cristo Mountains and is entirely within the Sangre de Cristo Wilderness. The area contains the complete watershed of Deadman Creek from approximately elevation 9,200 to 13,600 feet. Because most of the middle and upper parts of this watershed are covered with aspen, this RNA provides good representation for aspen forests over a wide range of elevations, slopes, and aspects. Some of this aspen forest is seral to Engelmann spruce and subalpine fir, and at lower elevations, to Douglas-fir forests; and some aspen is probably climax aspen forest. The area also provides good representation for many alpine ecosystem types within the Sangre de Cristo Mountains and for riparian vegetation types along the stream bottom. Significant areas of mountain mahogany shrubland, oatgrass meadows, and wetland vegetation also occur within the area. This remote area does not have a maintained Forest Service trail and receives little recreational use. See Table D-1 which shows the Series and Plant Associations, including representation and acreage, that were found in this proposed Research Natural Area.

Table D-1. Plant Series/Plant Associations, representation, and acreage for Deadman Creek proposed RNA

Series/Plant Association	Representation ^{1/}	Acres
Coniferous Forest Series	m	242
<i>Abies lasiocarpa</i> - <i>Picea engelmannii</i> /	m	
<i>Vaccinium myrtillus</i>		
<i>Pseudotsuga menziesii</i> / <i>Arctostaphylos</i>	m	

adenotricha-Juniperus communis

Deciduous Forest Series No plot data Most of this type is probably seral to coniferous forest	M	1046
Shrubland Series <i>Cercocarpus montanus</i> / <i>Bouteloua gracilis</i> ^{2/}	m m	325
Grassland/Forbland Series <i>Danthonia intermedia</i> / <i>Deschampsia</i> <i>cespitosa</i> <i>Festuca thurberi</i> / <i>Festuca arizonica</i>	M M M	2324
Wetland Series <i>Calamagrostis canadensis</i> -Mesic forb ^{2/} <i>Populus tremuloides</i> / <i>Salix</i> spp I Mesic graminoid ^{2/}	m m m	103
Non-vegetated (rock outcrop)	m	737

^{1/} An "M" in the Representation column indicates that a series or plant association is well-represented in the proposed RNA Minor or poorly represented series and plant associations are indicated by an "m" in the Representation column Nomenclature follows Johnston (1987)

^{2/} Possible new plant association, not described by Johnston (1987)

Finger Mesa Proposed RNA

This 3,406 acre area occurs on the Divide Ranger District in the eastern San Juan Mountains Finger Mesa is an isolated erosional remnant of a Tertiary volcanic plateau As a self-contained landscape unit, it provides a complete mountain summit and surrounding slopes ranging in elevation from 11,200 to 12,300 feet The area is distinguished by an extensive alpine area composed of a mosaic of kobresia turf, boulder fields, and areas of low alpine willows. Near treeline, tufted-hairgrass meadows occur near significant areas of sedge-dominated wetlands The subalpine Engelmann spruce/subalpine fir (spruce/fir) forests contain some aspen at lower elevations and are interspersed with Thurber fescue and oatgrass meadows. There are no Forest Service trails in this area, and the area receives minimal recreational use. See Table D-2 which shows the Series and Plant Associations, including representation and acreage, that were found in this proposed Research Natural Area

Table D-2. Plant Series/Plant Associations, representation, and acreage for Finger Mesa proposed RNA

Series/Plant Association	Representation ^{1/}	Acres
Coniferous Forest Series	M	1010
<i>Abies lasiocarpa</i> - <i>Picea engelmannii</i> /	M	
<i>Arnica cordifolia</i>		
<i>Abies lasiocarpa</i> - <i>Picea engelmannii</i> /	M	
<i>Vaccinium myrtillus</i>		
<i>Picea engelmannii</i> / <i>Festuca thurberi</i>	m	
Shrubland Series	m	550
<i>Salix brachycarpa</i> / <i>Vaccinium</i>	m	
<i>cespitosum</i>		
Grassland/Forbland Series	M	1096
<i>Festuca thurberi</i> - <i>Festuca arizonica</i>	m	
<i>Kobresia myosuroides</i> - <i>Acomastylis rossii</i>	M	
Wetland Series	m	100
<i>Carex aquatilis</i> - <i>Carex utriculata</i>	m	
<i>Deschampsia cespitosa</i> - <i>Caltha</i>	m	
<i>leptosepala</i>		
<i>Salix phylicifolia</i> ssp. <i>planifolia</i> /	m	
<i>Deschampsia cespitosa</i>		
Non-vegetated (rock outcrop)	m	650

^{1/} An "M" in the Representation column indicates that a series or plant association is well-represented in the proposed RNA. Minor or poorly represented series and plant associations are indicated by an "m" in the Representation column. Nomenclature follows Johnston (1987).

Hot Creek Proposed RNA

This 1,773 acre area is located on the Conejos Peak Ranger District on the western margin of the San Luis Valley in the San Juan Mountains and ranges in elevation from 8,600 to 9,400 feet. The area is significant because it contains rare exemplary occurrences of ponderosa pine forests with a grass understory of Arizona fescue and mountain muhly. These plant communities are common at low to middle elevations on the Rio Grande National Forest but over most of the Forest they have been affected by livestock grazing, logging, or developed recreation. The small but vertical walled canyons of Hot Creek and Piedrosa Creek have made this trailless area fairly inaccessible and allowed it to remain in natural condition. See Table D-3 which shows the Series and Plant Associations, including representation and acreage, that were found in this proposed Research Natural Area.

Table D-3. Plant Series/Plant Associations, representation, and acreage for Hot Creek proposed RNA.

Series/Plant Association	Representation ^{1/}	Acres
Coniferous Forest Series	M	1670
<i>Abies concolor-Pseudotsuga menziesii/</i>	m	
<i>Acer glabrum</i>		
<i>Abies concolor-Pseudotsuga menziesii/</i>	m	
<i>Arctostaphylos adenotricha</i>		
<i>Picea pungens/Alnus incana ssp. tenuifolia</i>	m	
<i>Pinus ponderosa/Festuca arizonica</i>	M	
<i>Pinus ponderosa-Pseudotsuga menziesii/</i>	M	
<i>Muhlenbergia montana</i>		
Shrubland Series		93
<i>Alnus incana ssp. tenuifolia/Swida sericea</i>	m	
<i>Swida sericea/Ribes inerme</i>	m	
Wetland Series	m	10
No plot data		

^{1/} An "M" in the Representation column indicates that a series or plant association is well-represented in the proposed RNA. Minor or poorly represented series and plant associations are indicated by an "m" in the Representation column. Nomenclature follows Johnston (1987).

Little Squaw Creek Proposed RNA

Containing the complete watershed of Little Squaw Creek, this 20,100 acre area occurs within an unglaciated remnant of a Tertiary volcanic plateau in the eastern San Juan Mountains. Located on the Divide Ranger District entirely within the Weminuche Wilderness, it extends in elevation from 9,200 feet near the Rio Grande River to 13,014 feet at the summit of Chief Mountain. The complete watershed, large land area, and diverse ecological conditions are important features of this proposed RNA. In addition, the area is significant for its high elevation rolling plateau that contains Thurber fescue and tufted hairgrass grasslands, extensive wetlands, willow stands, and alpine tundra. Subalpine spruce/fir forests mixed with some aspen stands occur at lower elevations. Little Squaw Creek is the only major creek in this part of the San Juan Mountains that does not have a Forest Service trail along it. The meadows and riparian vegetation of this creek are an especially significant feature of this area. Two Forest Service trails provide access and receive recreational use. See Table D-4 which shows the Series and Plant Associations, including representation and acreage, that were found in this proposed Research Natural Area.

Table D-4. Plant Series/Plant Associations, representation, and acreage for Little Squaw Creek proposed RNA

Series/Plant Association	Representation ^{1/}	Acres
Coniferous Forest Series	M	10,957
<i>Abies lasiocarpa</i> - <i>Picea engelmannii</i> /		
<i>Arnica cordifolia</i>	M	
<i>Abies lasiocarpa</i> - <i>Picea engelmannii</i> /		
<i>Calamagrostis canadensis</i>	m	
<i>Picea engelmannii</i> / <i>Festuca thurberi</i>	m	
<i>Picea engelmannii</i> / <i>Juniperus communis</i>	M	
<i>Picea engelmannii</i> /moss	m	
<i>Picea engelmannii</i> / <i>Vaccinium myrtillus</i>	M	
Shrubland Series	M	4714
<i>Salix arctica</i> / <i>Acomastylis rossii</i>	m	
<i>Salix glauca</i> - <i>Salix brachycarpa</i> /		
<i>Deschampsia cespitosa</i>	M	
Grassland/Forbland Series	M	3262
<i>Acomastylis rossii</i> / <i>Bistorta bistortoides</i>	m	
<i>Carex elynoides</i> / <i>Acomastylis rossii</i>	M	
<i>Danthonia intermedia</i> / <i>Deschampsia</i>		
<i>cespitosa</i>	m	
<i>Deschampsia cespitosa</i> / <i>Acomastylis rossii</i>	m	
<i>Deschampsia cespitosa</i> / <i>Elymus trachycaulus</i>	m	
<i>Festuca thurberi</i> / <i>Danthonia parryi</i>	m	
<i>Festuca thurberi</i> / <i>Festuca arizonica</i>	m	
<i>Festuca thurberi</i> / <i>Festuca idahoensis</i>	m	
<i>Kobresia myosuroides</i> - <i>Acomastylis rossii</i>	m	
Dry, rocky alpine turf - unnamed p a	M	
Wetland Series	M	499
<i>Carex aquatilis</i> - <i>Pedicularis</i>	M	
<i>groenlandica</i>		
<i>Carex utriculata</i> / <i>Carex aquatilis</i>	M	
<i>Deschampsia cespitosa</i> / <i>Caltha leptosepala</i>	M	
<i>Salix phylicifolia</i> ssp <i>planifolia</i> /		
<i>Caltha leptosepala</i>	M	
<i>Salix phylicifolia</i> ssp <i>planifolia</i> /	M	
<i>Deschampsia cespitosa</i>		
<i>Salix geyeriana</i> - <i>Salix</i> spp / <i>Calamagrostis</i>		
<i>canadensis</i>	m	
<i>Salix</i> spp /mesic forb - unnamed p a	m	
Non-vegetated (rock outcrop)	m	668

^{1/} An "M" in the Representation column indicates that a series or plant association is well-represented in the proposed RNA. Minor or poorly represented series and plant associations are indicated by an "m" in the Representation column. Nomenclature follows Johnston (1987).

Mill Creek Proposed RNA

This 2,555 acre area rises from the broad alluvial fan on the western slope of the Sangre de Cristo Mountains and is partially contained within the Sangre de Cristo Wilderness. Located on the Saguache Ranger District, it extends in elevation from 7,960 to 12,878 feet at the summit of Gibson Peak. The extensive and high quality pinyon/juniper woodlands on the relatively gentle slopes of alluvial fans and steeper bedrock extending up to about 9,000 feet are the principal feature of this area. In addition, mixed conifer and subalpine forests extend up to treeline on Gibson Peak. Subalpine grasslands blend into higher elevation alpine vegetation above treeline. Some riparian vegetation occurs along Mill Creek. There are no trails within the area, but some hiking access is provided to lower elevations by the remnants of an old mining road. This area receives negligible recreational use. See Table D-5 which shows the Series and Plant Associations, including representation and acreage, that were found in this proposed Research Natural Area.

Table D-5. Plant Series/Plant Associations, representation, and acreage for Mill Creek proposed RNA.

Series/Plant Association	Representation ^{1/}	Acres
Coniferous Forest Series	M	819
<i>Abies concolor-Pseudotsuga menziesii/</i>		
<i>Acer glabrum</i>	m	
<i>Abies concolor-Pseudotsuga menziesii/</i>		
<i>Holodiscus dumosus</i>	m	
<i>Abies concolor-Pseudotsuga menziesii/</i>		
<i>Jamesia americana</i>	m	
<i>Abies lasiocarpa-Picea engelmannii/</i>		
<i>Vaccinium myrtillus</i>	M	
Deciduous Forest	m	21
<i>Populus angustifolia-Picea engelmannii/</i>		
<i>Amelanchier alnifolia</i>	m	
<i>Populus angustifolia-Picea engelmannii/</i>		
<i>Distegia involucreta</i>	m	
Woodland Series	M	1404
<i>Pinus edulis/Bouteloua gracilis</i>	M	
<i>Pinus edulis/Stipa sribneri</i>	M	
<i>Pinus edulis/Stipa comata</i>	M	
Shrubland Series	m	67
<i>Holodiscus dumosus/Ribes cereum</i>		
Grassland/Forbland Series	m	212
<i>Acomastylis rossii/Trisetum dasyphyllum</i>	m	
Dry alpine turf - unnamed p a	m	
Non-vegetated (rock outcrop)	m	32

^{1/} An "M" in the Representation column indicates that a series or plant association is well-represented in the proposed RNA. Minor or poorly represented series and plant associations are indicated by an "m" in the Representation column. Nomenclature follows Johnston (1987).

North Zapata Proposed RNA

Located on the Conejos Peak Ranger District, this 6,114 acre area is part of the steep western slope of the Sangre de Cristo Mountains and is entirely within the Sangre de Cristo Wilderness. The area consists of a series of steep ridges separated by deep, narrow canyons containing the drainages of North and South Arrastre Creeks, North Zapata Creek, and Tellurium Gulch. Vegetation extends from pinyon/juniper woodlands beginning at approximately 8,600 feet to alpine tundra at 12,300 feet. The area is notable for its high elevation limber pine stands mixed with bristlecone pine and an understory dominated by Thurber fescue. North-facing slopes support mixed montane forest, and above 11,000 feet, subalpine coniferous forest. South-facing slopes support open shrubland and woodland plant communities. Aspen stands, subalpine grasslands, and riparian forests also occur within the area. A Forest Service trail provides access to the southern boundary of the area. See Table D-6 which shows the Series and Plant Associations, including representation and acreage, that were found in this proposed Research Natural Area.

Table D-6. Plant Series/Plant Associations, representation, and acreage for North Zapata proposed RNA

Series/Plant Association	Representation ¹¹	Acres
Coniferous Forest Series	M	3354
<i>Abies lasiocarpa</i> - <i>Picea engelmannii</i> /Moss	M	
<i>Picea engelmannii</i> / <i>Vaccinium myrtillus</i>	M	
<i>Pinus aristata</i> / <i>Festuca thurberi</i>	M	
<i>Pseudotsuga menziesii</i> / <i>Arctostaphylos</i>		
<i>adenotricha</i> - <i>Juniperus communis</i>	M	
<i>Abies concolor</i> - <i>Pseudotsuga menziesii</i> / <i>Acer glabrum</i>	M	
Deciduous Forest Series	m	525
<i>Populus tremuloides</i> / <i>Festuca arizonica</i>		
Woodland Series	M	1026
<i>Pinus edulis</i> / <i>Bouteloua gracilis</i>	M	
Shrubland Series	m	293
Scree shrubland - unnamed p a	m	
Grassland/Forbland Series	M	820
Transitional grassland - unnamed p.a	m	
Dry alpine turf - unnamed p a	M	
Alpine forb meadow - unnamed p.a	m	
Wetland Series	m	5
Not sampled		
Non-vegetated (rock outcrop)	m	91

¹¹ An "M" in the Representation column indicates that a series or plant association is well-represented in the proposed RNA. Minor or poorly represented series and plant associations are indicated by an "m" in the Representation column. Nomenclature follows Johnston (1987).

Spring Branch Proposed RNA

Located in the eastern foothills of the San Juan Mountains, this 4,053 acre area occurs on the Divide Ranger District and ranges in elevation from 8,200 to 10,200 feet. Most of this proposed RNA is rolling topography covered by a mosaic of different grassland types and pinyon/juniper woodland. At higher elevations on the slopes of Horseshoe Mountain, montane forest is primarily Douglas-fir mixed with limber pine and small areas of aspen. Pinyon/juniper woodland is the dominant woody vegetation type in the area. The grasslands are similar to those of the short-grass prairie further east and occur in a complex mosaic of types that include the following species: blue grama, western wheatgrass, Arizona fescue, muhly, Indian ricegrass, needlegrass, junegrass, and others. Small areas of shrubland, which include mountain mahogany, snowberry, and currant, occur on ridges and ridge slopes among the pinyon/juniper woodland. This area is winter range for deer and elk and receives most human usage during the hunting season. Forest Development Road 327 (Cedar Springs Road), which is not included within the RNA boundaries, divides the area into two parts and provides access into its center. See Table D-7 which shows the Series and Plant Associations, including representation and acreage, that were found in this proposed Research Natural Area.

Table D-7. Plant Series/Plant Associations, representation, and acreage for Spring Branch proposed RNA

Series/Plant Association	Representation ^{1/}	Acres
Coniferous Forest Series	m	211
<i>Pseudotsuga menziesii/Festuca arizonica</i>	m	
Woodland Series	m	511
<i>Pinus edulis/Bouteloua gracilis</i>	m	
Grassland/Forbland Series	M	3331
<i>Pascopyrum smithii/Bouteloua gracilis</i>	M	
<i>Bouteloua gracilis/Atriplex canescens</i>	M	
<i>Festuca arizonica/Muhlenbergia montana</i>	m	

^{1/} An "M" in the Representation column indicates that a series or plant association is well-represented in the proposed RNA. Minor or poorly represented series and plant associations are indicated by an "m" in the Representation column. Nomenclature follows Johnston (1987).



APPENDIX E

**Threatened, Endangered, Proposed,
Candidate, Sensitive, Special
Concern Plants and Significant
Plant Communities**

APPENDIX E

Threatened, Endangered, Proposed, Candidate, Sensitive, Special Concern Plants and Significant Plant Communities

INTRODUCTION

There are 40 species of plants and six plant communities identified on the RGNF that are specifically recognized by the US Fish and Wildlife Service, USDA Forest Service, or the Colorado Natural Heritage Program (CNHP). Table E1 presents Threatened, Endangered, Proposed, Candidate, Sensitive, Special Concern Plants, and Significant Plant Communities reported from the Rio Grande National Forest. This table shows the global and state ranks and the federal and state legal status for each species known from the Forest. The information is based on several sources (CNHP 1994, CNHP 1996; USDI Fish and Wildlife Service 1994; USDI Fish and Wildlife Service 1996).

Table E-1. Threatened, Endangered, Proposed, Candidate, Sensitive, Special Concern Plants, and Significant Plant Communities reported from the Rio Grande National Forest

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK ^{1/}	STATE RANK ^{1/}	FEDERAL STATUS ^{2/}	STATE STATUS ^{3/}	FEDERAL SENSITIVE ^{4/}
PLANTS						
<i>Aquilegia saximontana</i>	Rocky Mountain columbine	G3	S3	(3C)		
<i>Aster alpinus var vierhapperi</i>	alpine aster	GUTU	S1			
<i>Astragalus brandegei</i>	Brandegee milkvetch	G5	S1S2	(3C)		BLM
<i>Astragalus ripleyi</i>	Ripley milkvetch	G3?	S2	(C2)		FS
<i>Botrychium echo</i>	echo moonwort	G2	S2			FS
<i>Botrychium hesperium</i>	western moonwort	G3	S2			
<i>Botrychium lanceolatum var lanceolatum</i>	lance-leaved moonwort	G5T4	S2			
<i>Botrychium lunaria</i>	moonwort	G5	S2			
<i>Botrychium pallidum</i>	pale moonwort	G2	S2	(C2)		FS
<i>Carex limosa</i>	mud sedge	G5	S?			
<i>Chionophila jamesii</i>	Rocky Mountain snowlover	G4?	S3S4			
<i>Comarum palustre</i>	marsh cinquefoil	G5	S1S2			
<i>Corydalis caseana ssp brandegei</i>	sierra corydalis	G5T3	S3			
<i>Crepis nana</i>	dwarf hawksbeard	G5	S2			
<i>Cryptogramma stelleri</i>	slender rock-brake	G5	S2			
<i>Cystopteris montana</i>	mountain bladder fern	G5	S1			
<i>Draba exunguiculata</i>	clawless draba	G3	S2	(3C)		
<i>Draba fladnizensis</i>	arctic draba	G4	S2S3			
<i>Draba graminea</i>	San Juan whittlow-grass	G2	S2			
<i>Draba grayana</i>	Gray's Peak whittlow-grass	G2	S2			
<i>Draba rectifructa</i>	mountain whittlow-grass	G3	S2			
<i>Draba smithii</i>	Smith whittlow-grass	G2	S2	(C2)		FS
<i>Draba spectabilis var oxyloba</i>		G3T3Q	S3			
<i>Draba streptobrachia</i>	Colorado Divide whittlow-grass	G3	S3			

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK ^{1/}	STATE RANK ^{1/}	FEDERAL STATUS ^{2/}	STATE STATUS ^{3/}	FEDERAL SENSITIVE ^{4/}
<i>Eriogonum brandegei</i>	Brandegee wild buckwheat	G1G2	S1S2	(C1)		FS
<i>Eriophorum altaicum</i> var <i>neogaeum</i>	Altai cottongrass	G4T?	S2			FS
<i>Eriophorum gracile</i>	slender cottongrass	G5	S2			
<i>Gilia penstemonoides</i>	Black Canyon gilia	G3	S2S3	(3C)		FS
<i>Goodyera repens</i>	dwarf rattlesnake-plantain	G5	S2			
<i>Ipomopsis multiflora</i>	many-flowered gilia	G4	S1			
<i>Isoetes echinospora</i>	spiny-spored quillwort	G5?	S2			
<i>Lilium philadelphicum</i>	wood lily	G5	S3			
<i>Machaeranthera coloradoensis</i>	Colorado tansy-aster	G2?	S2			FS
<i>Neoparrya lithophila</i>	rock-loving neoparrya	G2	S2	(3C)		FS
<i>Platanthera sparsiflora</i> var <i>ensifolia</i>	canyon bog-orchid	G4G5T3	S2			
<i>Potentilla ambigens</i>	southern Rocky Mtn cinquefoil	G3	S1S2			
<i>Pyrola picta</i>	pictureleaf wintergreen	G4G5	S2			
<i>Senecio dimorphophyllus</i> var <i>intermedius</i>	different groundsel	G4T2	S1	(3C)		
<i>Stellaria irrigua</i>	Altai chickweed	G4?	S2	(3C)		
<i>Woodsia neomexicana</i>		G4	S2			
SIGNIFICANT NATURAL PLANT COMMUNITIES						
<i>Festuca arizonica</i> - <i>Muhlenbergia filiculmis</i>	montane grasslands	G3	S2			
<i>Festuca arizonica</i> - <i>Muhlenbergia montana</i>	montane grasslands	GU	SU			
<i>Pinus aristata</i> / <i>Festuca arizonica</i>	montane woodlands	G4	S3			
<i>Pinus edulis</i> -(<i>Juniperus monosperma</i>)/ <i>Stipa scribneri</i>	foothills pinyon-juniper woodlands	G2G3	S1?			
<i>Pinus ponderosa</i> / <i>Festuca arizonica</i>	lower montane forests	G5	S4			
<i>Pseudotsuga menziesii</i> / <i>Juniperus communis</i>	lower montane forests	G5	S?			

^{1/} **COLORADO NATURAL HERITAGE PROGRAM RANKINGS:**

The following are used by the Colorado Natural Heritage Program to set protection priorities for natural heritage resources. Natural Heritage Resources, or "NHRs," are rare, threatened, or endangered plant and animal species, and rare and exemplary natural communities. The primary criterion for ranking NHRs is the number of populations or occurrences (i.e., the number of known distinct localities). Also of great importance is the number of individuals in existence at each locality or, if a highly mobile organism (e.g., large mammals, many birds, and butterflies), the total number of individuals. Other considerations may include the quality of the occurrences, the number of protected occurrences, and existing or potential threats to the population. However, the emphasis remains on the number of populations or occurrences so that ranks will be an index of known biological rarity. **These ranks should not be interpreted as legal designations** (CNHP 1996).

Global Rank (G): Based on the range-wide status of a species

Global Rank	Rank Definition
G1	Critically imperiled globally because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction (Critically endangered throughout its range)
G2	Imperiled globally because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range (Endangered throughout its range)
G3	Very rare or local throughout its range or found locally in a restricted range (21 to 100 occurrences) (Threatened throughout its range)
G4	Apparently secure globally, though it might be quite rare in parts of its range, especially at the periphery
G5	Demonstrably secure globally, though it might be quite rare in parts of its range, especially at the periphery
GX	Presumed extinct
G#?	Indicates uncertainty about an assigned global rank
GU	Unable to assign rank due to lack of available information
GQ	Indicates uncertainty about taxonomic status
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.

State Rank (S): Based on the status of a species in an individual state. S ranks may differ between states based on the relative abundance of a species in each state.

<u>State Rank</u>	<u>Rank Definition</u>
S1	Critically imperiled in state because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extirpation from the state (Critically endangered in the state)
S2	Imperiled in state because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extirpation from the state (Endangered or threatened in state)
S3	Rare in state (21 to 100 occurrences)
S3S4	Watchlisted, specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted
S#B	Refers to breeding season imperilment of elements that are not permanent residents
S#N	Refers to the non-breeding season imperilment of elements that are not permanent residents Where no consistent location can be discerned for migrants or non-breeding populations, a rank of SZN is used
SZ	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected
SH	Historically known from the State, but not verified for an extended period, usually >15 years, this rank is used primarily when inventory has been attempted recently
SX	Presumed extirpated from state
S#?	Indicates uncertainty about an assigned state rank
SU	Unable to assign rarity rank, often because of low search effort or cryptic nature of the element
SA	Accidental in the state
SR	Reported to occur in the state, but unverified
S?	Unranked, some evidence that species may be imperiled, but awaiting formal rarity ranking

^{2/} **FEDERAL LEGAL STATUS**

The standard abbreviations for federal endangerment status developed by the U.S. Fish and Wildlife Service, Division of Endangered Species and Habitat Conservation are used here. The federal abbreviations are:

- LE Endangered, taxa formally listed as endangered
- E(S/A) Endangered due to similarity of appearance with listed species
- LT Threatened; taxa formally listed as threatened
- P Proposed E or T, taxa formally proposed for listing as endangered or threatened
- C Candidate, taxa for which the Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened

Please note that the U.S. Fish and Wildlife Service has issued a Notice of Review in the February 28 Federal Register for plant and animal species that are "Candidates" for listing as endangered or threatened under the Endangered Species Act. The revised candidate list replaces an old system that listed many more species under three categories: Category 1 (C1), Category 2 (C2), and Category 3 (including 3A, 3B, 3C). Candidate species listed in the February 28 Federal Register are indicated here with a C. Former Category 1 through Category 3 codes are noted in parenthesis, e.g., (C2). The former ranking system for Category 1 through Category 3 is as follows:

- (C1) FORMALLY Notice of Review, Category 1 taxa for which substantial biological information exists on file to support proposing to list as endangered or threatened
- (C2) FORMALLY Notice of Review, Category 2 taxa for which current information indicates that proposing to list as endangered or threatened is possible, but appropriate or substantial biological information is not on file to support an immediate rulemaking
- (C2*) FORMALLY Notice of Review, Category 2* taxa believed to be possibly extirpated in the wild
- (3A) FORMALLY Notice of Review, Category 3A taxa for which the USFWS has persuasive evidence of extinction
- (3B) FORMALLY Notice of Review, Category 3B names that based on current taxonomic knowledge do not represent taxa meeting the Endangered Species Act's definition of a species
- (3C) FORMALLY Notice of Review, Category 3C taxa that have proven to be more abundant or widespread than was previously believed, and/or those that are not subject to any identifiable threat

^{3/} **STATE LEGAL STATUS**

The abbreviations for the legal state endangerment status are similar to those used to indicate federal endangerment status. None of the plants listed in Table E1 have state legal status. The state abbreviations are as follows:

E	Endangered
T	Threatened
SC	Special Concern

^{4/} **FEDERAL SENSITIVE**

FS	Forest Service designated Sensitive species
BLM	Bureau of Land Management designated Sensitive species

THREATENED, ENDANGERED, AND PROPOSED PLANTS

An Endangered plant is one which is in danger of extinction throughout all or a significant portion of its range. A Threatened plant is one which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. A Proposed plant is one that has been officially proposed by the USDI Fish and Wildlife Service (FWS) for listing as threatened or endangered under the Endangered Species Act (ESA).

Threatened and Endangered plants are determined and listed by the USDI Fish and Wildlife Service in 50 CFR Part 17 (USDI Fish and Wildlife Service 1994, USDI Fish and Wildlife Service 1996). There are presently no documented records or suspected occurrences of Threatened or Endangered plants on this Forest. Threatened and Endangered plants in Colorado have unique habitats or ranges that do not occur on this Forest. There are also no plants proposed for listing that occur on the Rio Grande National Forest (USDI Fish and Wildlife Service 1996).

CANDIDATE PLANTS

These are plant species for which the FWS has on file sufficient information on biological vulnerability and threats to support proposals to list them as endangered or threatened. These are documented in the FWS's program advice to its Regional Directors for preparation of listing packages or documented in a current Federal Register Notice of Review for threatened or endangered listing. Please note that the U.S. Fish and Wildlife Service has issued a Notice of Review in the February 28 Federal Register for plant and animal species that are "Candidates" for listing as endangered or threatened under the Endangered Species Act. The revised candidate list replaces an old system that listed many more species under three categories: Category 1 (C1), Category 2 (C2), and Category 3 (including 3A, 3B, 3C). There are no Candidate plant species on the RGNF (see Table E1).

SENSITIVE PLANTS

The Forest Service (1991) defines a sensitive plant as one which is not presently listed as Threatened or Endangered by the FWS, but a population viability concern has been identified as evidenced by:

- a) Significant current or predicted downward trend in population numbers or density
- b) Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution

The Regional Forester has identified sensitive species for the Rocky Mountain Region (Regional Supplement 2600-94-2); there are nine sensitive plants reported on the Rio Grande National Forest. Reported locations of sensitive plants came from Forest files and records from the CNHP. Table E1 lists the sensitive plant species reported on the Forest.

Habitat for Sensitive Plants

The habitats and known distributions for the nine sensitive plant species are described below. Habitats and distribution data come from Colorado Native Plant Society (1989), Colorado Natural Heritage Program (1994; 1995, 1996), Fertig (1994), Harrington (1954), Komarek (1994), Lightfoot (1995), Naumann (1990), O'Kane (1988), State of Colorado (1991), USDI Fish and Wildlife Service (1994, 1996), and Weber (1987, 1990; 1996a, 1996b)

Ripley milkvetch (*Astragalus ripleyi*) -- This plant exhibits a high degree of habitat specificity. It is apparently restricted to volcanic substrates, in open-canopy ponderosa pine-Arizona fescue savannah. It is also found along the edges of mixed coniferous forest where Arizona fescue is dominant. Northerly aspects are more frequently represented than others, but populations have been reported on all aspects (Naumann 1990). An endemic plant of the lower San Luis Valley and northern New Mexico, it is known in Colorado only from Conejos County. The reported records on the Forest are near the Conejos River and near Terrace Reservoir. Elevation range is from 7,730 to 9,450 feet with most populations occurring between 8,100 and 9,200 feet. Plants may be palatable to livestock, deer, elk, and rabbits. In areas receiving heavy grazing pressure, robust plants may be found in the protection of shrub crowns. There also appears to be significant impact to plants from insects (harvester ants, tree hoppers, and others).

Echo moonwort (*Botrychium echo*) -- This inconspicuous plant is found in the subalpine zone and is generally found on sparsely vegetated, gravelly to rocky surface soils. It appears to be an early successional plant, coming into disturbed areas where ground cover is sparse. The plant is known from Boulder, Clear Creek, Gilpin, Jackson, Larimer, San Miguel, Teller, and Conejos Counties in Colorado. There is a reported record on the Rio Grande National Forest near Lookout Mountain. The full elevational range is unknown but is typically found around 10,000 to 11,000 feet (personal communication July 14, 1994 between Peter Root, *Botrychium* specialist, and Dean Erhard). Root's opinion is that rabbits and voles probably graze *Botrychium* species. He is not aware of livestock grazing this genus.

Pale moonwort (*Botrychium pallidum*) -- This inconspicuous plant is also found in similar habitats as *Botrychium echo*. The plant is known from Boulder, Teller, Gunnison, Park, and Conejos Counties in Colorado. There is a reported record on the Rio Grande National Forest near Lookout Mountain. The full elevational range is unknown, but is typically found around 10,000 to 11,000 feet (personal communication July 14, 1994 with Peter Root and Dean Erhard). See above for grazing palatability.

Smith whitlow-grass (*Draba smithii*) -- This plant is found in rock crevices and talus slopes in the southern mountains -- from the upper Rio Grande Valley to the Mesa de Maya. There are reported records on the Forest from the Wagon Wheel Gap, Bellows Creek, and Dry Gulch areas of Mineral County and from the Lake Fork of Crestone Creek in Saguache County. This plant is known from Custer, Lake, Las Animas, Saguache, and Mineral Counties in Colorado. The elevational range is from 8,000 to 11,000 feet. There is no information on palatability of this plant. The habitat makes it relatively inaccessible to most animals.

Brandegei wild buckwheat (*Eriogonum brandegei*) -- This plant is found on relatively steep banks and more level open sagebrush or pinyon-juniper stands. It is often on clay banks and flats in soils derived from limestone to shale. This plant is known from Chaffee, Fremont, Park, El Paso, and Saguache (?) Counties in Colorado. The reported record on the Rio Grande National Forest is from the South Park area on the Saguache Ranger District in 1947 by G W Kelly. According to O'Kane (1988), it is highly suspected that Kelly collected the plant in the Salida area but inadvertently listed South Park as the collection location. Repeated attempts to find the plant in South Park have failed to find the plant or suitable habitat (O'Kane 1988). Palatability is unknown.

Altai cottongrass (*Eriophorum alatum* var. *neogaeum*) -- This plant is found in subalpine and alpine bogs and riparian areas. It is typically associated with marsh-marigold, water sedge, rose crown, king's crown, bistort, and elephantella. The plant is known from Gunnison, Eagle, Park, Saguache, and San Juan Counties in Colorado. The reported record on the Rio Grande National Forest is from the Kite Lake area at 12,600 feet and the Cherry Lake area in the Sangre de Cristo Mountains at 12,300 feet. Palatability is unknown, but due to the boggy habitat, ungulate use is probably infrequent to none.

Black Canyon gilia (*Gilia penstemonoides*) -- This plant is found in rock crevices and cliff habitat. There are two reported populations on the Forest at 9,000 to 10,000 feet. The plant is known from Gunnison, Hinsdale, Montrose, Ouray, and Mineral Counties in Colorado. It flowers from early June to late August. Plants are spaced 5 to 20 inches apart in the cracks in which they grow. There are two reported occurrences of this plant on the RGNF in the Creede area. There is no information on palatability, but the habitat makes it relatively inaccessible to most animals.

Colorado tansy-aster (*Machaeranthera coloradoensis*) -- This low, prostrate, mat-plant is found on gravelly sites. It is known to grow on relatively barren slopes and ridges. It is an endemic species of south-central Wyoming and western Colorado. Harrington (1954) reports this plant occurring in south-central, west-central, and southwestern parts of Colorado from 9,000 to 11,000 feet. There are two reported occurrences on the RGNF in the North Clear Creek area west of Creede at around 10,000 feet in elevation. There is a reported record on the San Juan National Forest at 12,600 feet. This plant is known from the following counties in Colorado: San Juan, Pitkin, Lake, and Hinsdale. This plant probably is not at high risk from grazing, based on field observations in Wyoming. The feeling is that the plant is probably somewhat unpalatable (Fertig 1994). Also, the sparseness of the habitat probably does not encourage animal use. There could be some risk of trampling under heavy stocking conditions.

Rockloving aletes (*Neoparrya lithophila*) -- This plant is known to occur on north-facing cliffs and ledges or shelves and cracks of the north face of late-Tertiary volcanic dikes, lava flows, and igneous outcrops. It is endemic to south-central Colorado. There are reported records on the Forest from the Elephant Rocks area. It is known from Chaffee, Conejos, Huerfano, Rio Grande, and Saguache Counties in Colorado. It appears to occur below 8,700 feet on the RGNF. Initial observations in the Elephant Rocks area suggest that this plant is not palatable or is not preferred by local wildlife species.

SPECIAL CONCERN PLANTS AND SIGNIFICANT NATURAL PLANT COMMUNITIES

The Colorado Natural Heritage Program (CNHP) is the state's representative in a global network of Conservation Data Centers now numbering 124, including one in each of the 50 United States. Recognizing the need for priorities in conservation planning, The Nature Conservancy (TNC) developed the Heritage methodology. The data are focused on ecosystems and species, their biology, habitats, locations, conservation status and management needs. The system is dependent on known locations rather than predictions, thereby having the capability to establish current priorities for conservation. Special concern plants are those ranked as "Watchlisted" (ranking S3S4) and rarer within the state. Significant natural plant communities that are rare or exemplary merit listing. Each species or community is ranked according to rarity and legal status. The absence of a species or community from the RGNF list does not necessarily mean that these species or communities do not exist on Forest lands. It may mean that their occurrence has not yet been reported and entered into the CNHP Biological and Conservation Database (BCD)

Special Concern Plants

There are 40 plant species that the CNHP considers special concern (includes sensitive plants). Special concern species that are not designated sensitive do not have legal status nor are they officially recognized by Forest Service policy or Manual direction. However, they are a component of the biological diversity on the RGNF. Many of these species' occurrences are not well documented, and therefore, make the CNHP list due to a lack of occurrence records. Special concern plants reported on the RGNF were previously displayed in Table E-1. The known Colorado county distribution for special concern plants is shown in Table E-2. Sensitive plants are shown in **bold** font.

Table E-2. Documented Colorado County distribution for Special Concern Plants

SCIENTIFIC NAME	DOCUMENTED COUNTY OCCURRENCE IN COLORADO ^{1/}
<i>Aquilegia saximontana</i>	Known from Teller, Larimer, Clear Creek, Boulder, El Paso, Park, Summit, Jackson, Gilpin, Jefferson, and Conejos Counties
<i>Aster alpinus</i> var <i>vierhapperi</i>	Known from Grand and Mineral Counties
<i>Astragalus brandegei</i>	Known from Conejos, Gunnison, Mineral, and Fremont Counties
<i>Astragalus ripleyi</i>	Known from Conejos County
<i>Botrychium echo</i>	Known from Boulder, Clear Creek, Conejos, Gilpin, Jackson, Larimer, San Miguel, and Teller Counties
<i>Botrychium hesperium</i>	Known from Larimer, Clear Creek, Boulder, Conejos, and Lake Counties
<i>Botrychium lanceolatum</i> var <i>lanceolatum</i>	Known from Conejos, Larimer, Boulder, San Juan, Jackson, and El Paso Counties
<i>Botrychium lunaria</i>	Known from Teller, Clear Creek, Jackson, Larimer, Park, El Paso, San Juan, and Conejos Counties
<i>Botrychium pallidum</i>	Known from Teller, Gunnison, Boulder, Park, and Conejos Counties
<i>Carex limosa</i>	Known from Jackson and Conejos Counties

<i>Chionophila jamesii</i>	Known from Conejos, Montezuma, Lake, Park, Boulder, Chaffee, Gunnison, Larimer, Clear Creek, and Summit Counties
<i>Comarum palustre</i>	Known from Conejos, Gunnison, Larimer, and Mesa Counties
<i>Corydalis caseana</i> ssp. <i>brandegei</i>	Known from Archuleta, Conejos, Delta, Gunnison, Hinsdale, Mineral, and Garfield Counties
<i>Crepis nana</i>	Known from Custer, Lake, Boulder, Gunnison, Pitkin, Park, Clear Creek, and Chaffee Counties
<i>Cryptogramma stelleri</i>	Known from Summit, Gunnison, Ouray, La Plata, Archuleta, Grand, San Juan, and Conejos Counties
<i>Cystopteris montana</i>	Known from San Juan, Summit, Ouray, Gunnison, Grand, and Conejos Counties
<i>Draba exunguiculata</i>	Known from Clear Creek, Grand, Lake, Park, Gilpin, Conejos, Summit, Boulder, and El Paso Counties
<i>Draba fladnizensis</i>	Known from Boulder, Clear Creek, Park, Saguache, San Juan, Summit, Larimer, and Rio Grande Counties
<i>Draba graminea</i>	Known from Hinsdale, La Plata, Ouray, San Juan, and San Miguel Counties
<i>Draba grayana</i>	Known from Clear Creek, Gilpin, Grand, Lake, Larimer, Park, Summit, Chaffee, and Saguache Counties
<i>Draba rectifracta</i>	Known from Rio Grande, Mineral, and Eagle Counties
<i>Draba smithii</i>	Known from Custer, Las Animas, Mineral, Saguache, and Lake Counties
<i>Draba spectabilis</i> var. <i>oxyloba</i>	Known from Conejos, San Juan, Gunnison, and Delta
<i>Draba streptobrachia</i>	Known from Conejos, Hinsdale, La Plata, Mineral, Ouray, Park, Pitkin, San Miguel, Clear Creek, Jackson, Lake, and San Juan Counties
<i>Eriogonum brandegei</i>	Known from Chaffee, Fremont, Park, El Paso, and Saguache Counties
<i>Eriophorum altaicum</i> var. <i>neogaeum</i>	Known from San Juan, Eagle, Park, Gunnison, and Saguache Counties
<i>Eriophorum gracile</i>	Known from Conejos, Grand, Jackson, Larimer, Las Animas, Park and San Juan Counties
<i>Gilia penstemonoides</i>	Known from Gunnison, Hinsdale, Montrose, and Mineral Counties
<i>Goodyera repens</i>	Known from Clear Creek, Custer, El Paso, Jefferson, La Plata, Las Animas, and Mineral Counties
<i>Ipomopsis multiflora</i>	Known from Conejos County
<i>Isoetes echinospora</i>	Known from Larimer, El Paso, and Conejos Counties
<i>Lilium philadelphicum</i>	Known from Archuleta, Boulder, Custer, Douglas, El Paso, Hinsdale, Huefano, Jefferson, La Plata, Larimer, Las Animas, Mineral, Park, Clear Creek, Gilpin, Gunnison, Teller, Rio Grande Counties
<i>Machaeranthera coloradoensis</i>	Known from San Juan, Pitkin, Lake, Mineral, and Hinsdale Counties
<i>Neoparrya lithophila</i>	Known from Chaffee, Conejos, Huerfano, Rio Grande, and Saguache Counties
<i>Platanthera sparsiflora</i> var. <i>ensifolia</i>	Known from Conejos, Eagle, Gunnison, Mesa, Montrose, Ouray, Pitkin, Routt, Saguache, Garfield, Archuleta, and San Miguel Counties
<i>Potentilla ambigens</i>	Known from Larimer and Mineral Counties
<i>Pyrola picta</i>	Known from Boulder, El Paso, Garfield, Jackson, Mineral, Routt, La Plata, and Conejos Counties
<i>Senecio dimorphophyllus</i> var. <i>intermedius</i>	Known from Mesa, Montezuma, Montrose, Ouray, Conejos, and Hinsdale Counties
<i>Stellaria irrigua</i>	Known from Gunnison, Mineral, San Juan, San Miguel, Hinsdale, La Plata, Custer, and Conejos Counties
<i>Woodsia neomexicana</i>	Known from Las Animas, Baca, Alamosa, El Paso, Fremont, and Teller Counties
1/ Based on literature cited in this appendix	

There are only two plant species, *Astragalus ripleyi* and *Ipomopsis multiflora*, with reported occurrences in only one county in Colorado. *Astragalus ripleyi* is considered a regional endemic species and is only known from Conejos County, Colorado and Taos and Rio Arriba Counties in New Mexico. *Ipomopsis multiflora* is known from Conejos County, Colorado and from New Mexico to southern Nevada and Arizona

Significant Natural Plant Communities

There are six significant natural plant communities identified by the CNHP and they are shown in the lower portion of Table E-1, and in Table E-3 below. There has been low search effort and inventory on the Forest for exemplary natural plant communities. Communities shown as relatively rare on the Forest by the CNHP are probably attributed to low search effort and limited documentation in the CNHP's database, rather than true rarity. The relative rarity of each plant community is discussed below.

Table E-3. Significant Natural Plant Communities on the RGNF

1) Arizona fescue-slimstem muhly	<i>Festuca arizonica-Muhlenbergia filiculmis</i>
2) Arizona fescue-mountain muhly	<i>Festuca arizonica-Muhlenbergia montana</i>
3) bristlecone pine/Arizona fescue	<i>Pinus aristata/Festuca arizonica</i>
4) pinyon pine-(one-seed juniper)/ sribner needlegrass	<i>Pinus edulis-(Juniperus monosperma)/ Stipa sribneri</i>
5) ponderosa pine/Arizona fescue	<i>Pinus ponderosa/Festuca arizonica</i>
6) Douglas-fir/common juniper	<i>Pseudotsuga menziesii/Juniperus communis</i>

1) The Arizona fescue-slimstem muhly plant community is typically found in the Arizona Fescue on Mountain Slopes LTA (LTA 8). This LTA contains over 95,000 acres of which this community is a common component. Slimstem muhly is considered a species that increases as ecological deterioration occurs. For more information see Appendix A (RNV report) under nonforested communities and livestock grazing influence -- Montane Zone upland plant species which increase as ecological condition deteriorates. Slimstem muhly is common in the lower elevations on the Forest, especially those areas that have received heavy, historic grazing.

2) The Arizona fescue-mountain muhly plant community is also found in LTA 8. This community is a late-successional community. It is common on the RGNF in the Montane Zone where historic grazing did not induce ecological deterioration.

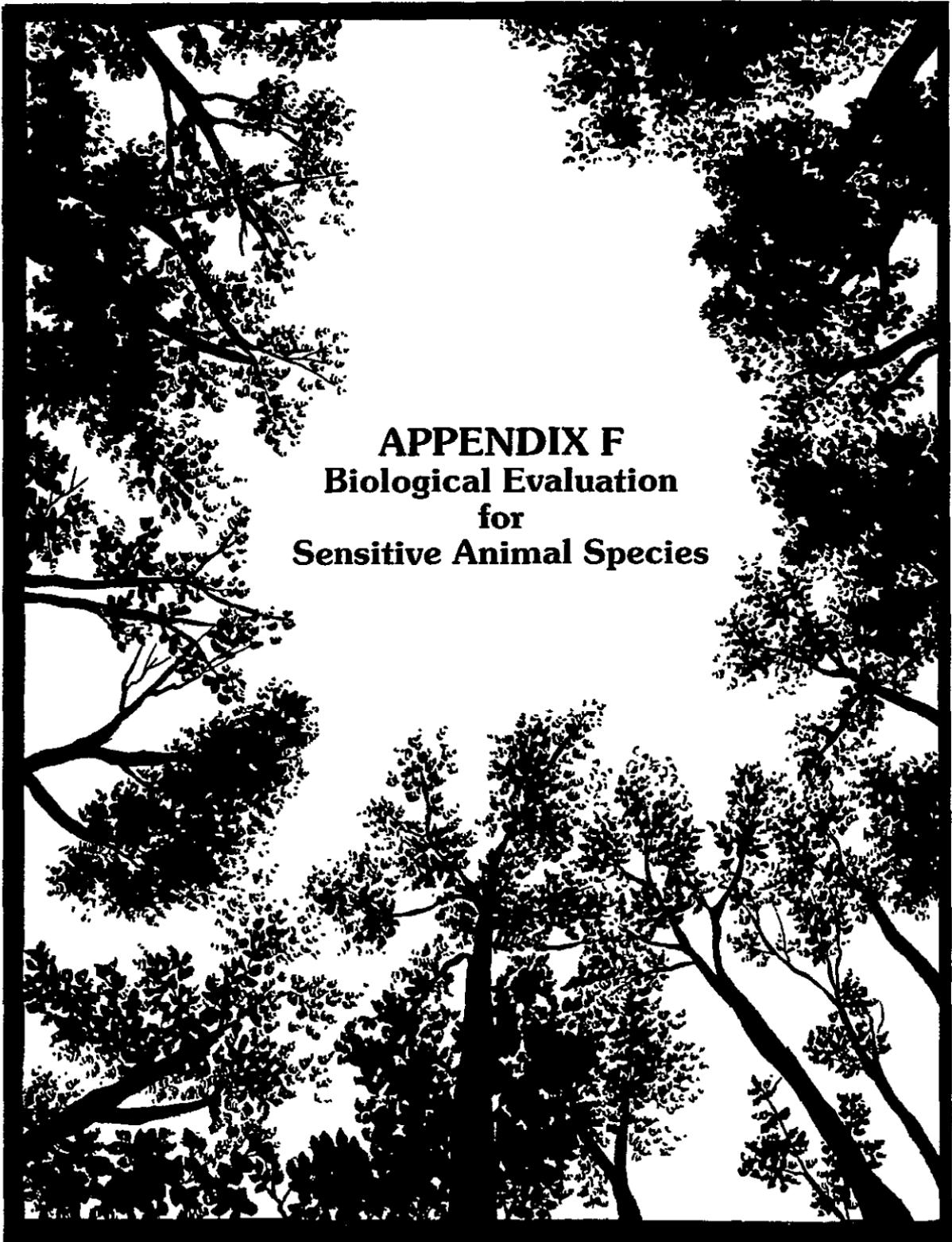
3) The bristlecone pine/Arizona fescue plant community is part of the bristlecone pine cover type (there are roughly 20,000 acres on the Forest). There are approximately 4,600 acres of bristlecone pine cover type on the Forest below 10,000 feet elevation. Most of these acres would have Arizona fescue as the understory grass.

4) The pinyon pine-(oneseed juniper)/sribner needlegrass plant community is part of the Pinyon on Mountain Slopes LTA (LTA 6). This LTA is over 85,000 acres on the

Forest Scribner needlegrass is a common understory plant in the pinyon pine woodland of the Foothills Zone.

5) The ponderosa pine/Arizona fescue plant community is part of the Ponderosa Pine and Douglas-fir on Mountain Slopes LTA (LTA 5). This LTA makes up over 102,000 acres on the RGNF. This is the most common plant community in LTA 5.

6) The Douglas-fir/common juniper plant community is found in the White Fir and Douglas-fir on Mountain Slopes LTA (LTA 3). This LTA comprises over 94,000 acres on the Forest. This community is one of the most common types found in this LTA.



APPENDIX F
Biological Evaluation
for
Sensitive Animal Species

APPENDIX F

Biological Evaluation for Sensitive Animal Species

INTRODUCTION

This Biological Evaluation provides an assessment of the effects of carrying out the alternatives considered in the Environmental Impact Statement for the Revised Forest Plan. It was prepared according to section 2670 of the Forest Service Manual.

In March of 1993, the Regional Forester published the initial list of Sensitive species for the Region. The Sensitive species list is a dynamic document that allows for necessary changes as new information becomes known.

Sensitive species are those where there is a suspected downward trend in population and/or where habitat is being lost. The designation serves as an early alert so that actions that would lead any species to be placed on the Threatened or Endangered list are avoided.

Based on the most recent list (March 21, 1994) there are three amphibians, one fish, fifteen birds, and five mammals known, or suspected of occurring, on the Forest.

The species and a synopsis of the habitat requirements were developed after a literature search. The list of literature included Bailey and Neidach, 1965, Hoover and Wills, 1984, Hammerson, 1986, Clark et al., 1989, Andrews and Richter, 1992; Finch, 1992, Fitzgerald et al., 1994, Hayward and Verner, 1994, and Ruggiero et al., 1994.

In addition, the known status of each species on the Forest is included.

FORESTWIDE INVENTORIES

In 1992 a Forestwide amphibian survey occurred. The survey was based upon recommendations from the District biologists who mapped out wetlands they felt had the greatest habitat potential for the amphibians on the Sensitive list. The local Division of Wildlife (DOW) followed up with a similar survey in 1994. In addition, each District has conducted project-level inventories.

The DOW conducted an extensive survey on and around the Forest to try and locate evidence of wolverines. The project covered about 500 square miles, over a three year period (1992-95), and used bait stations and remote cameras. The project was conducted in the summertime for 1992-94, and switched to the wintertime in 1994-95.

Inventories for Townsend's big-eared bat have been conducted since 1990 by the DOW and Colorado Division of Minerals and Geology checking for the presence of bats in abandoned mines on the Forest.

A by-product of the Forestwide surveys for Mexican Spotted Owls (1990-1994) was that other owls were surveyed as well.

AMPHIBIANS AND FISH

Boreal Toad (*Bufo boreas boreas*)

Boreal toads are found in wet or riparian ecosystems in the mountains of Colorado, primarily from 7,000 feet to over 11,860 feet

They require shallow pools or lake margins to deposit their eggs in come late May or early June. The transformation to adult takes two seasons (at elevations over 9,000 feet). Toad populations are found in areas characterized by willow, bog birch, and shrubby cinquefoil. These sites are typical of boggy areas in Colorado, like marshes, lake margins, and beaver ponds. Boreal toads hibernate, often using natural "chambers" near small stream beds (possibly holes dug by gophers or other small mammals). These animals occupy distinct home ranges of varying size and the breeding males may be territorial.

To date, the toad has only been found on the Divide District. In the spring of 1996 a breeding site was located on the Divide District. Historic records say that toads were found at Trujillo Meadows and Alamosa River Canyon (these areas were surveyed in the 1992 inventory).

Northern Leopard Frog (*Rana pipiens*)

The Northern Leopard Frog typically inhabits the banks and shallow portions of permanent water (e.g., beaver ponds, lakes, streams), especially those having rooted aquatic vegetation. They are most frequently observed at the water's edge, but sometimes roam far from water on rainy nights.

This species breeds in the shallow, nonflowing portions of permanent bodies of water and in seasonally flooded areas next to or contiguous with permanent pools. Breeding pools typically contain vegetation, mats of algae, and fairly clear water.

The 1992 and 1994 inventories and District inventories have not located any leopard frogs.

Rio Grande Cutthroat Trout: (*Oncorhynchus clarki virginalis*)

This subspecies is rare throughout its original range in Colorado and New Mexico. Two forms of the subspecies exist - one in the Rio Grande proper in Colorado and New Mexico, and the other in the Pecos River in New Mexico. It lives in high mountain streams, usually in the headwaters. The best waters are from 8,000-10,000 feet. The gradient should be less than 10%, preferably 3-4%. This subspecies is susceptible to angling pressure, so areas with little access are preferred. The species evolved without other salmonids present, so it does not compete well with other trout species. Therefore, the presence of a barrier to keep other trout from inhabiting the area is necessary. All trout are opportunistic feeders that

feed on many organisms, but invertebrates, both adult and drifting larvae, are the primary food. Invertebrates of terrestrial origin also make up a large part of the diet. These invertebrates are a result of healthy riparian areas.

There are 20 stream populations found on the Forest. Eleven of the populations are in situations where habitat condition is a concern, but there is no exotic trout present, seven of the populations are in situations that also contain exotic trout, and two of the populations are in situations with no habitat concerns or exotic trout. There are an additional 17 lake populations on the Forest.

Tiger Salamander: (*Ambystoma tigrinum*)

Tiger salamanders range throughout much of North America. They range throughout Colorado at elevations up to 12,000 feet. Tiger salamanders occur in virtually any habitat as long as there is a body of nonflowing water nearby for breeding. They inhabit ponds, lakes, and reservoirs from 10 feet in width to several acres. Sunny, mud-bottomed ponds at least 18-24 inches deep with a shallow beach-like shore are preferred. They are usually not present in waters inhabited by predatory fishes, bullfrogs, turtles, and crayfish. During the breeding season the species is often found at night after heavy rains. They live beneath debris near water or in crayfish or mammal burrows and usually spend the winter underground in rodent burrows. From April to July, depending on the weather, the salamanders return to the breeding ponds.

The 1992 and 1994 amphibian inventories and District inventories have located many different populations of the salamanders across the Forest.

BIRDS

Black Swift (*Cypseloides niger*)

Areas with rocky cliffs available for nesting, varying from ocean cliffs to mountain ledges, are home to the black swift. Foraging birds range at high elevations over most montane and adjacent lowlands. The bird nests in small colonies, from 5 to 15 pairs. Nests may be found on ledges or in caves. They may also be found in crevices or ledges on sheer, high, moist cliff faces, near or behind waterfalls or over pools.

There has been no structured survey to date for the swift. Its occurrence on the Forest has been discovered because of recreational bird watching and employees doing field work.

It is a rare, but consistently seen bird on the Forest. It is unknown whether it breeds on the Forest. Sightings have occurred on the Conejos Peak District.

Boreal Owl (*Aegolius funereus*)

The boreal owl is closely associated with spruce/fir zone forests (Figure F-1). Mature forests are necessary for nesting because the owls require large nesting cavities (3" diameter).

opening and 15" diameter tree at cavity), but the owls frequently use pole stands for hunting. They also use openings where perches are available (e.g., forest edges), especially in spring when snow cover is present under the forest canopy, but openings have melted. Because spruce/fir forests contain few cavities, forest types with abundant cavities within or next to spruce/fir forests may be ideal habitat.

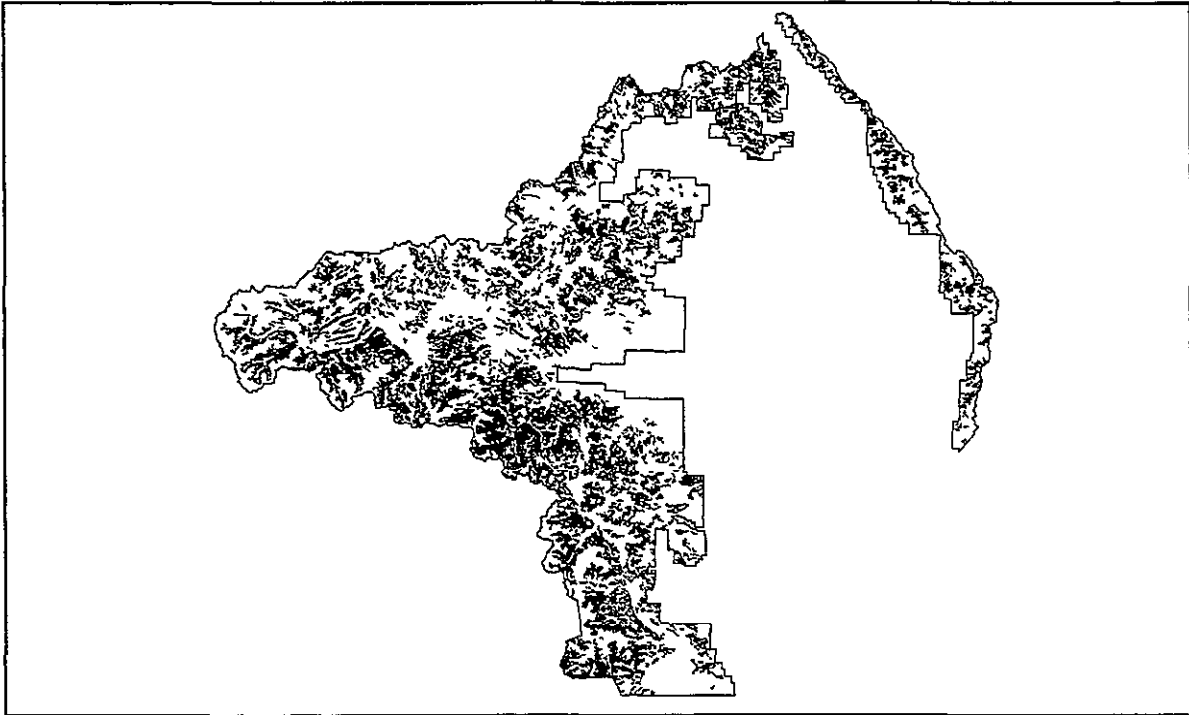


Figure F-1 Boreal Owl Potential Habitat

There have been no structured Forestwide inventories conducted for the owl. In the first year of the Mexican spotted owl surveys, direction was given to search all elevations. As a result, spruce/fir forests were inventoried. Some District project-level inventories have occurred. Sightings and/or vocalizations have been recorded on the Divide and Conejos Peak Districts. In addition, a young bird was found on the Creede part of the Divide District.

Burrowing Owl (*Athene cunicularia*)

The burrowing owl inhabits open grassland, prairies, and farmlands (Figure F-2). It is a ground-dwelling bird that is often attracted to prairie dog villages, where they find and use abandoned burrow nests. They are primarily nocturnal but are often seen in daylight perched near burrows on the ground, low fenceposts, or on small bushes. Their main prey is small mammals, but they are opportunistic and will feed on insects and small birds as well. Although owls are good for catching "pests" in farm fields, accidental poisoning has occurred by humans trying to rid their land of prairie dogs and other ground-dwelling mammals. The main threat to these owls is a loss of grassland habitat where primitive conditions still exist.

There have been no structured inventories conducted and no reported sightings for the owl on the Forest. Potential habitat exists on the Saguache and Divide Districts. Andrews and Righter (1992) consider it to be a rare to uncommon species for this part of the State.

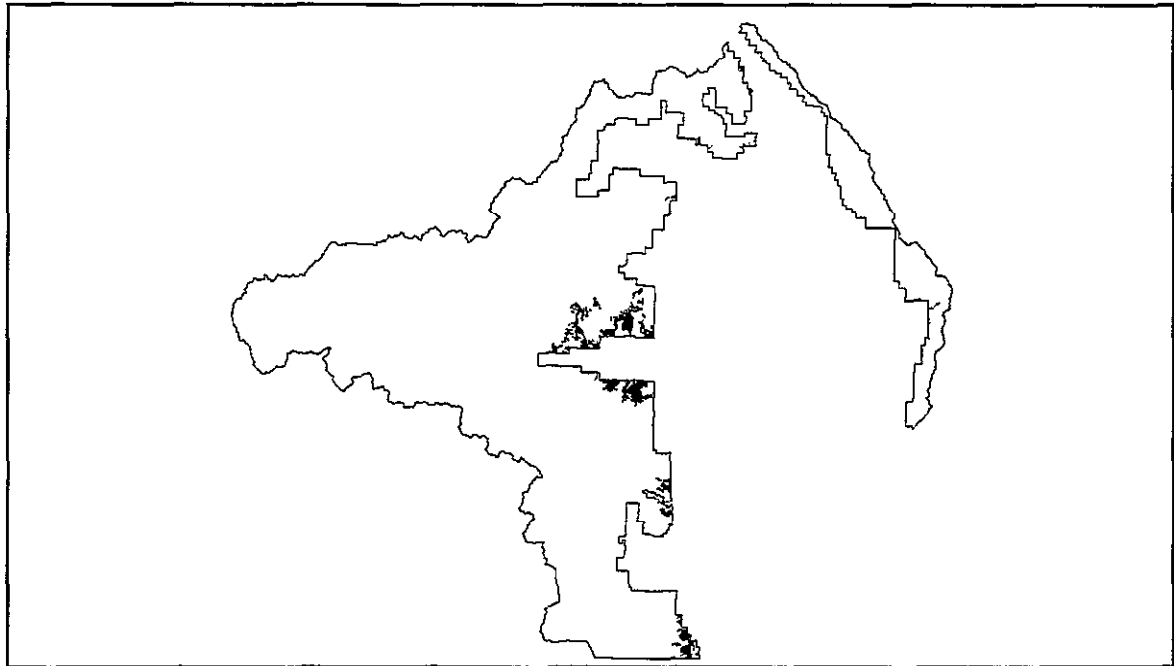


Figure F-2. Burrowing Owl, Ferruginous Hawk, and Loggerhead Shrike Potential Habitat

Ferruginous Hawk (*Buteo regalis*)

The ferruginous hawk is found in undisturbed western grasslands, arid shrublands, and badlands (Figure F-2). It nests on trees and bushes associated with bottomlands, and on ledges, large rocks, riverbanks, and hillsides. Nest sites are often much larger than other buteos (sometimes over three meters in height) and may be reused for several years. Nests are constructed of sagebrush, willow, or other shrub branches, and lined with shrub bark and cow dung. Nest sites are very vulnerable to human disturbance and may be abandoned during the pre-egg-laying period and incubation, even if disturbed only once. Ferruginous hawks hunt primarily in open country. Their nest sites often provide a vista of appropriate hunting areas. Their diet consists of small rodents, such as prairie dogs and ground squirrels, and sometimes locusts, birds, and crickets. Agriculture and severe overgrazing, which alter suitable nesting and foraging areas, provide the greatest threat to the hawk.

No structured inventories and no reported sightings of the hawk have occurred on the Forest. Potential habitat exists on the Saguache and Divide Districts. Andrews and Righter (1992) consider it to be a rare to uncommon species in this part of the State.

Loggerhead Shrike (*Lanius ludovicianus*)

The loggerhead shrike inhabits open country with scattered shrubs or small trees, such as shelterbelts, cemeteries, farmsteads, or hedgerows in the Plains country and Midwest (Figure F-2). This species eats insects, mostly grasshoppers and crickets, small mammals, birds, and reptiles. Nests are a bulky mass of twigs and grass, lined with plant down and feathers, in a thorny shrub or tree.

There have been no structured Forestwide inventories conducted for the shrike. Recreational bird watching and employees doing field work have revealed that the shrike is a fairly common confirmed breeder on the Divide District.

Flammulated Owl (*Otus flammeolus*)

The flammulated owl is associated with the dry pine belt (Figure F-3). It forages primarily in late-successional stands of ponderosa pine that are pure or mixed with oak, pinyon pine, true fir, Douglas-fir, or aspen. The owl is a secondary cavity nester. Its primary prey are insects.

There have been no structured inventories for this owl. However, some Mexican spotted owl inventories were done in potential flammulated owl habitat, and flammulated owls were found across the Forest.

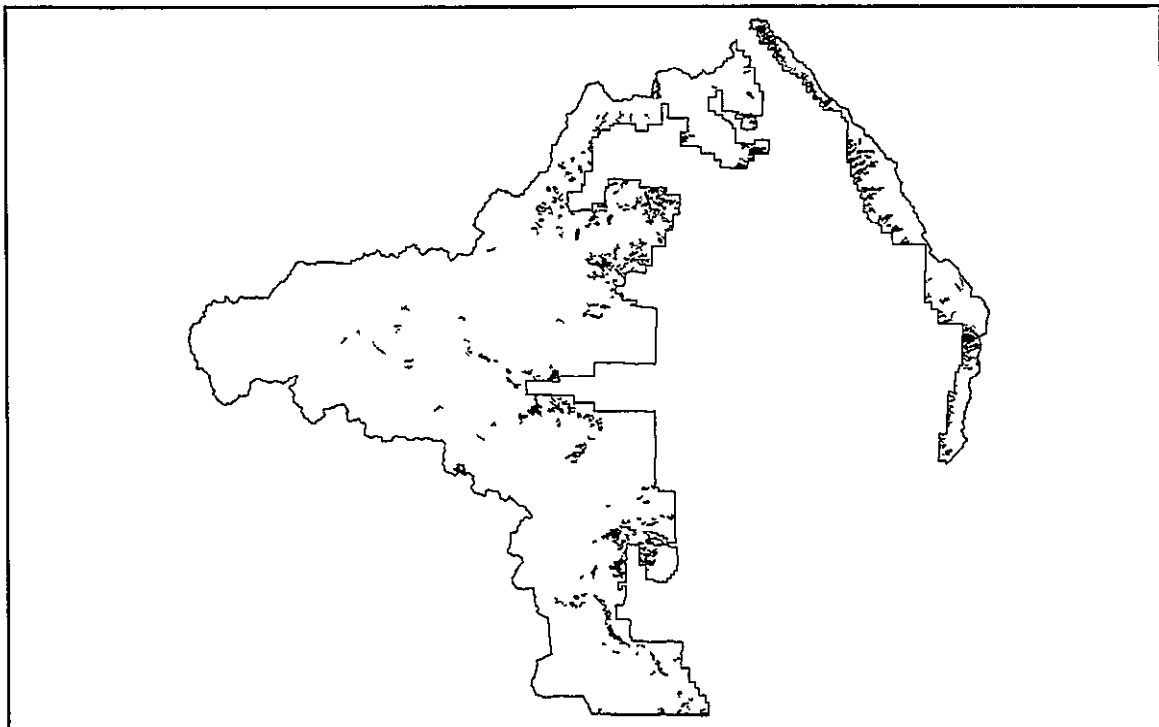


Figure F-3 Flammulated Owl Potential Habitat

Fox Sparrow (*Passerella iliaca*)

Riparian willow shrublands and wet, willow-grown meadows provide breeding areas for the fox sparrow. During migration and winter, the species uses wooded riparian areas.

There have been no structured inventories conducted for the sparrow. The sparrow has been sighted on the Saguache District.

Golden-crowned Kinglet (*Regulus satrapa*)

The Golden-crowned Kinglet breeds mainly in mature, dense spruce/fir forests and occasionally in limber pine and Douglas-fir forests (Figure F-4). In winter it occurs in coniferous forests (especially Douglas-fir or ponderosa pine), but also in other types such as pinyon-juniper woodlands, foothill and lowland riparian forests, planted conifer stands, and residential areas in the lowlands. During migration, it occurs in most wooded habitats.

In 1994 a study was conducted on the Forest to try to develop habitat relationships between neotropical migrant birds and spruce/fir habitat. The results confirmed what other studies had found, the kinglet was sighted most frequently in late seral-stage forests. (Carter 1995)

The kinglet has been spotted on the Divide and Conejos Peak Districts.

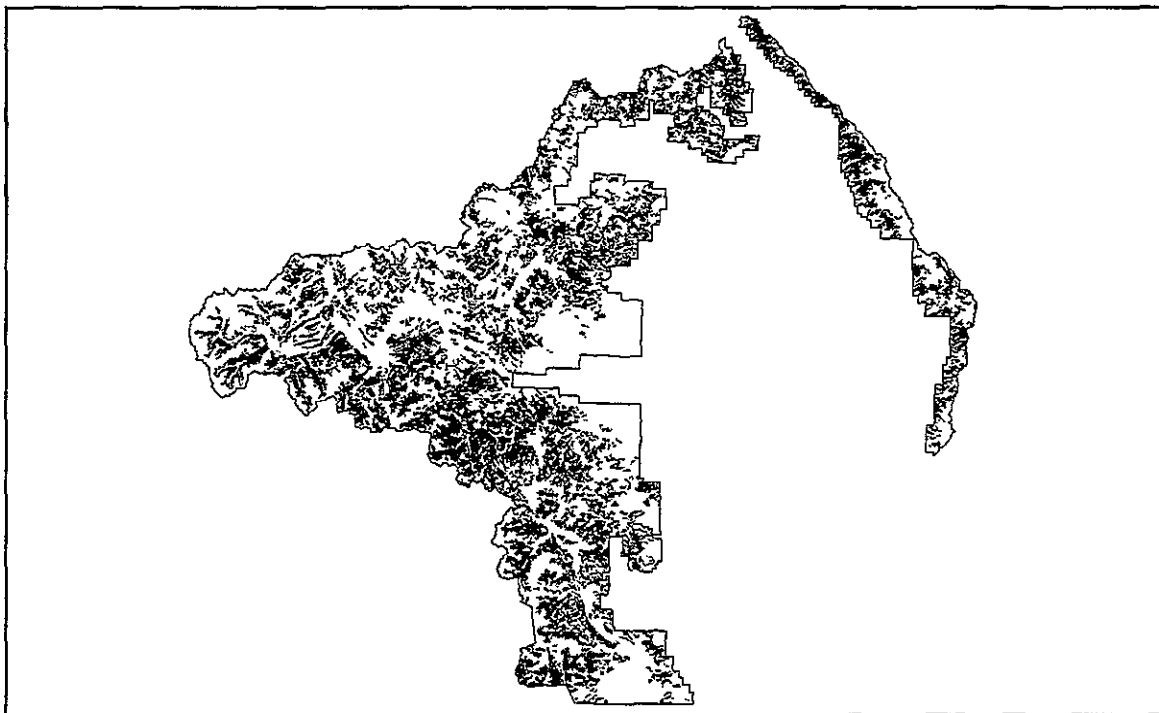


Figure F-4. Golden-crowned Kinglet Potential Habitat

Goshawk (*Accipiter gentilis*)

Goshawks can be found in any of the forested ecosystems on the Forest. The preferred cover habitat is in mature and late-successional structural stages (Figure F-5). They nest primarily in dense, mature conifers but may also use mixed conifer-aspen stands or aspen stands closely associated with conifers. The species is intolerant during nesting and will often defend an area up to 200 yards from the nest site. Nest sites may be reused on successive years.

There have been no structured Forestwide inventories conducted for the goshawk. Most known nest locations on the Forest are in aspen trees. Each District has conducted project-level inventories.

Goshawks have been found on every District, and five nests have been located.

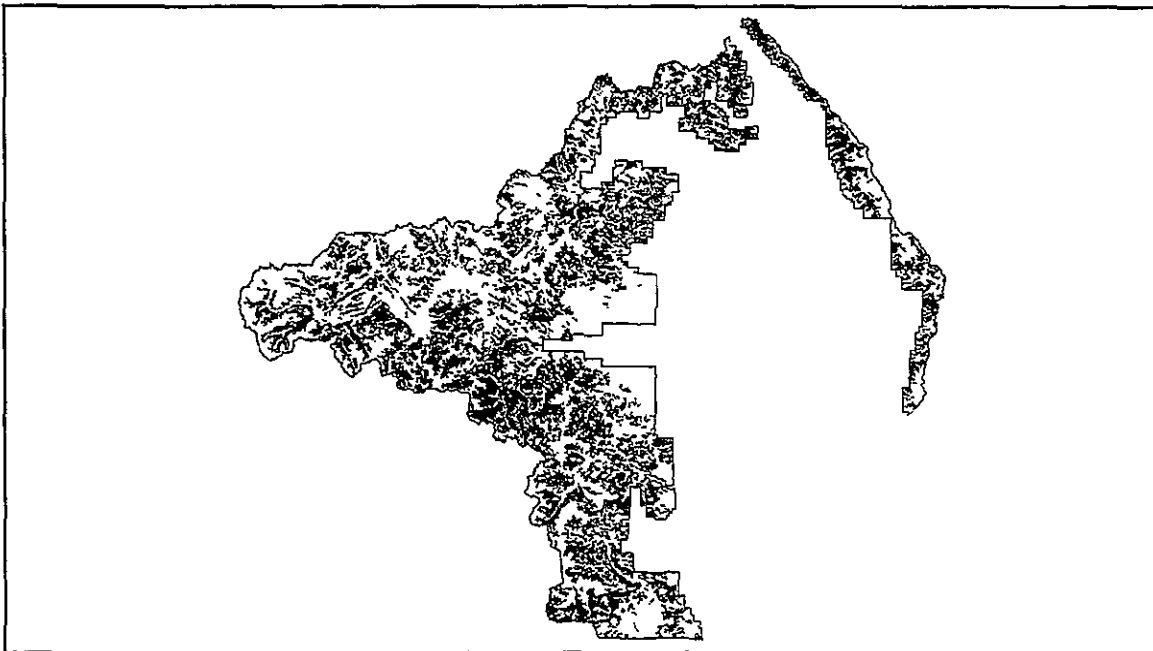


Figure F-5 Goshawk Potential Habitat

Lewis' Woodpecker (*Melanerpes lewis*)

Primarily associated with cottonwood riparian and ponderosa pine ecosystems in Colorado, this species prefers open park-like stands of trees with brushy understories. The Lewis' Woodpecker is a primary cavity nester, but also uses natural cavities. Both living and dead trees are used for nesting, but snags 15" DBH or greater are preferred. A snag density of one per 10 acres in cottonwoods or ponderosa pine is required. Burned-over areas attract this species, but it is also found in fringes of pine and juniper tree stands in deciduous forests, especially riparian forests. Lewis' Woodpeckers feed on flying insects during the spring and summer months and fruits and berries in late summer. It gathers food, including acorns if available, and stores the food in crooks of trees for winter. No specific cover requirements are known for this species.

There have been no structured Forestwide inventories conducted for the woodpecker, however, it has been located on the Conejos Peak and Divide Districts. The sightings are a result of recreational bird watching and employees doing field work.

Osprey (*Pandion haliaetus*)

Osprey use ponderosa pine, lodgepole pine, aspen, and high-elevation riparian during spring, summer, and fall. Since osprey feed almost exclusively on fish, a ready supply of fish free of contamination from chlorinated hydrocarbons is a habitat prerequisite. While muskrats, gulls, and ducklings may occasionally be taken, these prey species make up a minute portion of their diet. Forests at some distance from water are seldom used by ospreys, the extent of use being directly proportional to their distance from water. While ospreys will occasionally perch and rest in living trees with open crowns, snags or dead tops of living trees are definitely preferred, especially those closely oriented to water. Trees situated on small islands and narrow peninsulas are frequently used. Trees habitually used by osprey should be identified for retention.

There have been no structured Forestwide inventories conducted for the osprey. Sightings of the osprey have been due to recreational bird watching and employees doing field work. Ospreys have been seen on the Divide District.

Pygmy Nuthatch (*Sitta pygmaea*)

The pygmy nuthatch is found primarily in ponderosa pine forests, particularly in older stands (Figure F-6). This species is principally a secondary-cavity nester, although if no cavities are available it will excavate a cavity in a soft snag. Ponderosa pine are the preferred trees for nesting, but may also use aspen. The nuthatch is rarely found in spruce/fir, Douglas-fir, or pinyon-juniper stands. It feeds by gleaning the outer branches of mature trees. The average size of the breeding territory is three acres.

There have been no structured Forestwide inventories conducted for the nuthatch. Nuthatch sightings have been a result of recreational bird watching and employees doing field work. The nuthatch has been seen on all Districts.

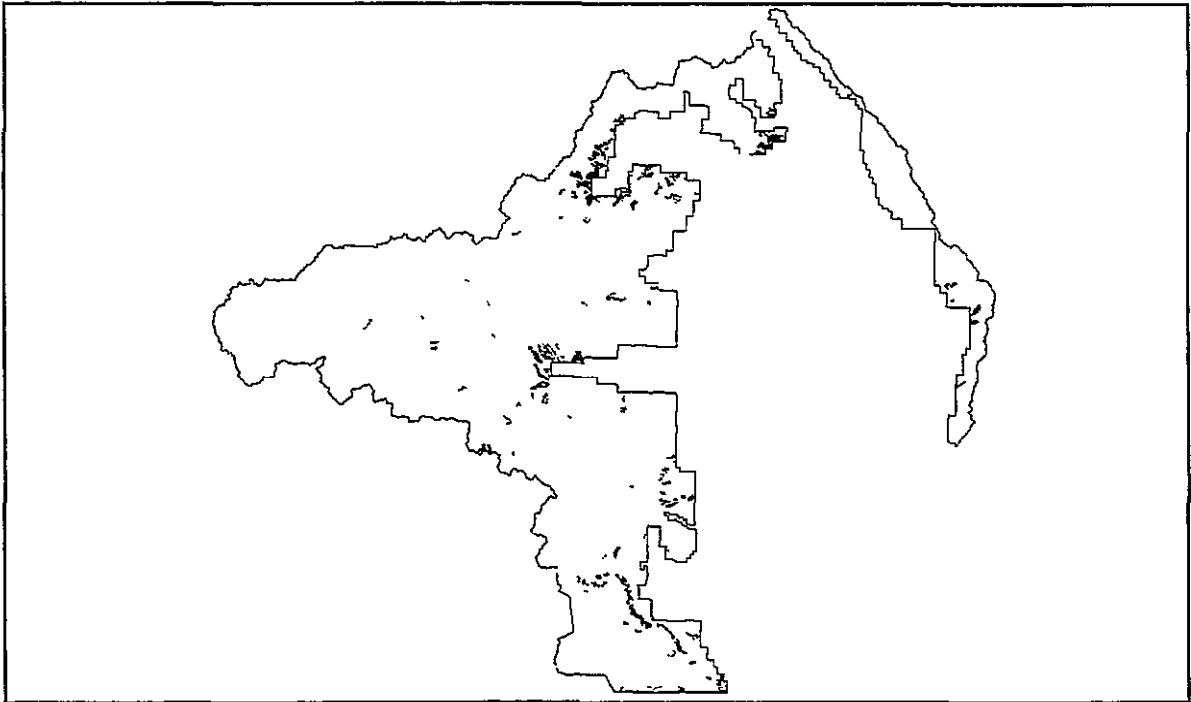


Figure F-6. Pygmy Nuthatch Potential Habitat

Olive-sided Flycatcher (*Contopus borealis*)

The olive-sided flycatcher inhabits montane and northern coniferous forests up to 10,000 feet in elevation, especially in burned-over areas with tall, standing-dead trees (Figure F-7). It seeks out tall, exposed perches, such as snags or high conspicuous dead branches. It prefers forests of tall spruces, firs, balsams, and pines, taiga, subalpine coniferous forests, mixed woodlands near edges and clearings or near wooded streams and bogs. The Flycatcher prefers stands with little canopy cover. It breeds primarily in mature spruce/fir and Douglas-fir, especially on steep slopes or near cliffs. During migration, it occurs in all types of wooded habitat.

The 1994 spruce/fir habitat-relationship study found that the flycatcher did not respond to particular patch sizes, shapes, or structural stages. It was assumed that the presence of snags was the most important habitat attribute (Carter 1995).

There have been no structured Forestwide inventories conducted for the flycatcher. Sightings of the flycatcher have been a result of recreational bird watching and employees doing field work. The flycatcher has been seen on all Districts.

Three-toed Woodpecker (*Picoides tridactylus*)

This woodpecker primarily inhabits spruce/fir forests of the West, but where insect populations are high it may also occur in ponderosa pine, Douglas-fir, aspen, and lodgepole pine forests (Figure F-7). At all seasons and elevations, this species is most common in years and areas where trees have high insect populations due to disease or fire. Nest cavities are

excavated in trees with heart rot, typically recently dead trees. This species prefers spruce/fir forests for nesting. These birds may excavate more than one cavity each breeding season. Snags at least 12 inches dbh and at least 15 feet high are preferred. Snag densities of 1 for every 5 to 7 acres are desirable. Clumping of snags may be beneficial. Night roosts, during the breeding season, are in cavities in very decayed, broken-topped dead trees. Roosting habitat during winter has not been documented.

There have been no structured Forestwide inventories conducted for the woodpecker. Sightings of the woodpecker have been a result of recreational bird watching and employees doing field work. Sighting of the woodpecker has occurred on all Districts. Carter (1995) did not locate many of them in his work and suggested that they might be naturally rare in spruce-fir forests that are unaffected by fire.

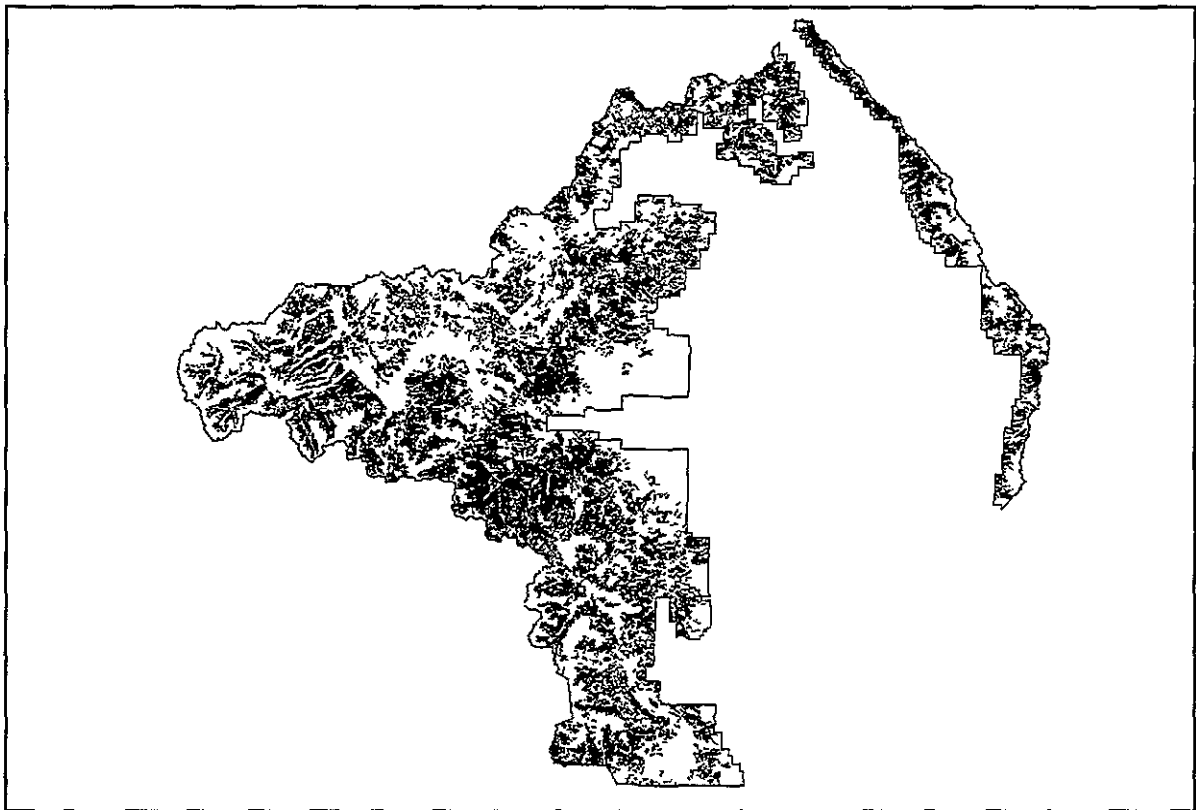


Figure F-7 Olive-sided Flycatcher and Three-toed Woodpecker Potential Habitat

White-faced Ibis (*Plegadis chihi*)

The white-faced ibis nests in large freshwater marshes. Nesting colonies are located in shrubs and low trees or in dense, standing reeds and tules, near or in marshes. The ibis feeds in shallow ponds, marshes, irrigated lands, and wet meadows.

There have been no structured Forestwide inventories conducted for the ibis. Sightings of the ibis have been as a result of recreational bird watching and employees doing field work.

While the ibis has not been located on the Forest, it has been seen on private wetlands within the Forest. It is a confirmed breeder on the San Luis Valley floor, which is near the Forest boundary.

MAMMALS

Dwarf Shrew (*Sorex nanus*)

Very little is known about the ecology, behavior, or reproductive cycles of the shrew. It has been found in a variety of habitats in the southern Rocky Mountains, ranging from the edges of alpine and subalpine rockslides to spruce-fir bogs, coniferous forests; sedge marsh; dry brushy hillsides, and open woodland. In Colorado it has not been captured at low elevations. It can apparently tolerate arid to semiarid conditions as captures have been made up to 8 km from water sources. The wide diversity of habitats where the species has been located indicated that it is perhaps more wide spread than existing records indicate.

There have been no structured Forestwide inventories conducted for the shrew.

Marten (*Martes americana*)

The marten prefers late-successional stands of mesic coniferous forest (Figure F-8). Consistent preference is not shown until stands reach the "mature" or "overmature" stage. Over 30 percent canopy cover is thought necessary for suitable marten habitat, with an optimum of 40-60 percent for resting and foraging. They tend to avoid habitats that lack overhead cover, although studies in Colorado have shown them to forage 0.8-3.2 km from the nearest forest stand. One apparent need is for some level of complex structure near the ground. This can be met in a variety of ways, fallen logs, lower branches of living trees, rock fields in forests, talus fields above treeline, shrubs, and squirrel middens. This structure

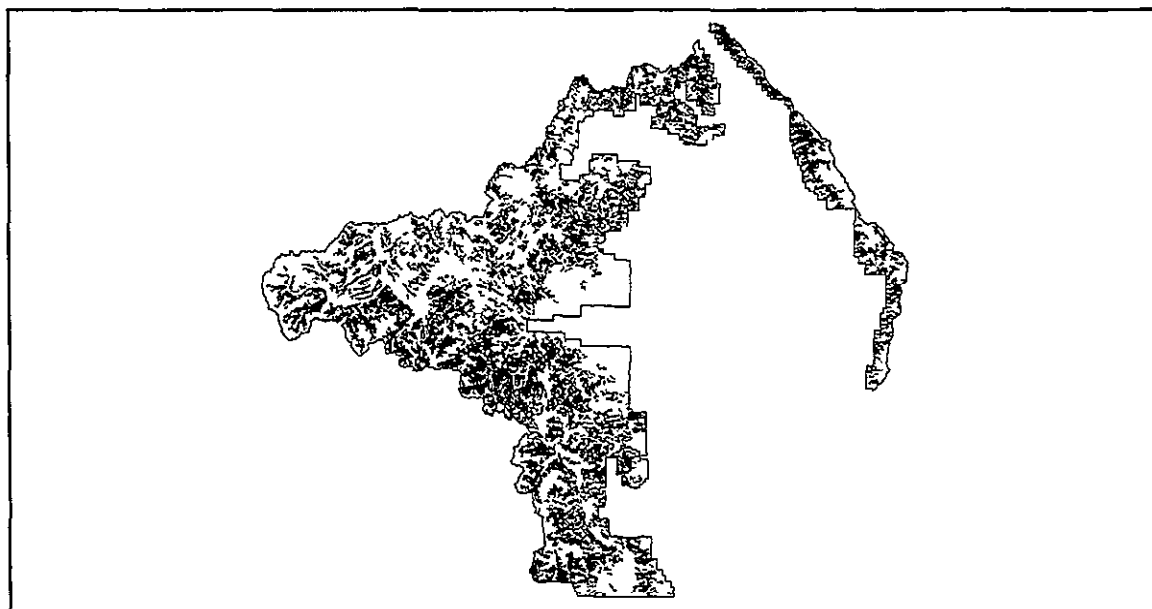


Figure F-8. Marten Potential Habitat

meets three important life needs: Protection from predation, access to subnivean spaces where most prey is captured in the winter, and protective thermal microenvironments

There have been no structured Forestwide inventories conducted for martens. There have been two District project-level inventories that involved winter tracking. Marten tracks were seen in both inventories. Marten were often spotted during the DOW wolverine inventory. Dave Kenvin (DOW-Monte Vista Terrestrial Biologist) who lead the project estimated that martens were seen on about 80% of the bait stations.

North American Lynx (*Felis lynx canadensis*)

In the mountains of western U S high quality lynx habitat consists of a mosaic of early-successional habitats with high snowshoe hare densities, and late-successional stands with downed woody debris for thermal and security cover and for denning (Figure F-9). Openings greater than 100 meters may create barriers to movement. In general, suitable travel cover consists of coniferous or deciduous vegetation greater than two meters in height with a closed canopy this is adjacent to foraging habitats. Small sized parcels (1-2 ha) of late-successional forest appear to be adequate for den sites, but they need to be connected by travel cover to permit females to move kittens to alternate den sites providing suitable access to prey.

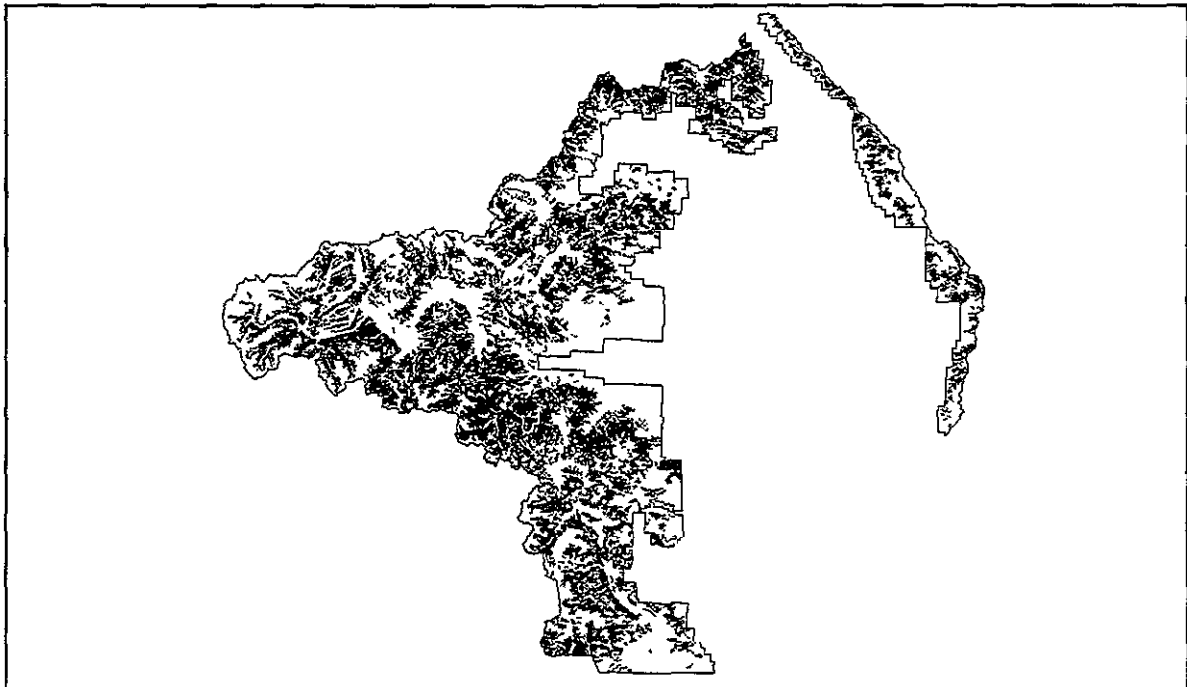


Figure F-9 North American Lynx Potential Habitat

There have been no structured Forestwide inventories for the lynx. The DOW's wolverine study had some cameras set up in potential lynx habitat, but no lynx were photographed.

There have been no recent confirmed sightings of lynx on the Forest. In the mid 1980s a lynx track was found along the East Fork of the San Juan River, near the Forest boundary. There are historic records of lynx occurring on the Forest, but they were never considered plentiful. In the early 1900s one was killed on Cumbres Pass.

North American Wolverine (*Gulo gulo luscus*)

The wolverine is found primarily in upper montane ecosystems including Douglas-fir, mixed conifer and lodgepole pine ecotypes, and alpine or marshy areas. Large and diverse ungulate populations are an important component of the habitat. It has been said that the habitat is probably best defined in terms of adequate year-round food supplies in large, sparsely inhabited wilderness areas, rather than in terms of particular types of topography or plant associations. They appear not to tolerate land-use activities that permanently alter habitats such as, agriculture, and urban and industrial development.

The DOW survey did not locate any evidence of wolverines. An early trapper's report said they were to be "not at all uncommon" near the headwaters of the Rio Grande River. Others have felt that populations were never high in the State.

Townsend's Big-eared Bat (*Plecotus townsendii*)

The Townsend's big-eared bat inhabits semidesert shrublands, pinyon juniper, and open montane forests. It is frequently associated with caves and abandoned mines for day roosts and hibernacula but will also use abandoned buildings and crevices on rock cliffs for refuge. During the summer single individuals may be encountered hanging in cracks of cliffs. They do not move long distances from hibernacula to summer roosts nor do they move or forage far from their day roosts. This species is a late-evening flyer. Caddisflies appear to be a staple of the diet, which also includes moths, flies, and other insects. They are gleaners, picking insects from leaves. Much of the foraging occurs over water, along the margins of vegetation, and over sagebrush. They are sensitive to fluctuations in humidity and temperature and move in response to them. Hibernacula with stable humidity and temperature appear to be a limiting resource. They are easily disturbed and leave where human harassment occurs even though such disturbance may be unintentional, this suggests that access to mines and caves should be closed or strictly limited.

The bat is known to occur at the Orient Mine, Terrace Reservoir, and the Sand Dunes, all of which are just outside the Forest boundary.

PROPOSED ACTION

The proposed action is the implementation of any of the alternatives described in Chapter II of the Draft Environmental Impact Statement. Incorporated with each alternative is a series of Standards and Guidelines (S&Gs). They describe management activities needed to

mitigate a potential impact and guide management toward a desired condition. As a result, they outline protective measures that would protect sensitive species habitat.

Specifically the Plan standards are:

Where new threatened, endangered, proposed, or sensitive species habitat is identified, an analysis shall be conducted to decide if any adjustments in the Forest Plan are needed.

Activities will be managed to avoid disturbance to sensitive species that would result in a trend toward federal listing or loss of population viability. The protection will vary depending on the species, potential for disturbance, topography, location of important habitat components, and other pertinent factors. Special attention will be given during breeding, young rearing, and other times that are critical to survival.

As new recovery plans, conservation agreements, conservation strategies, designation of critical habitat, or Regional documents which contain accepted management direction for TES species are developed, the Forest Plan will be reviewed to determine consistency with the new documents. Where appropriate, the Plan will be amended to incorporate the new direction.

In addition, according to Forest Service policy, another Biological Evaluation must be conducted before starting a project. This helps to prevent those impacts, which escape a Forest-scale analysis, from being considered.

AFFECTED ENVIRONMENT

Because the scale of this evaluation is Forestwide, some necessary lumping of habitat requirements was done. The desire was to have the habitat requirements expressed with data that was readily available at the Forest level.

To accomplish this task the described habitat requirements were translated into a Landtype Association (LTA) and structural class. LTAs were chosen instead of cover types for two reasons. First, they are an attempt to capture a basic biological unit (see LTA section in the EIS). Second, they better captured the juxtaposition of habitat a particular species would likely use. For instance, boreal owls use aspen stands, but primarily only within the spruce/fir zone (Hayward and Verner 1994). If one were to just look at aspen stands and call that potential habitat they could include aspen stands that were down in the ponderosa pine zone and unlikely to be used by boreal owls.

An example of the process follows. From the literature, marten habitat preferences were described as mesic, late-successional coniferous forests. These preferences were best captured by the Spruce and Douglas-fir LTAs since they are both mesic-forest types. Structural class 5 best captures the late-successional component. There are 651,570 acres that meet these conditions and will be considered as potential habitat. This does not imply that all these acres do provide habitat nor that these acres would result in a specific population number.

Table F-1 shows the preferred structure class (in parentheses after an X) by LTA, and the amount of potential of habitat. Figures F-1 - F-9 show how habitat is distributed across the Forest.

Table F-1. Preferred Structure Class by LTA and Acres of Potential Habitat

SPECIES	LANDTYPE ASSOCIATION						POTENTIAL HABITAT
	Spruce/ Fir	Willow Sedge	Ponderosa Pine	Douglas- Fir	Aspen	Western Wheat	
Boreal Toad		X					129,400 ¹
Leopard Frog		X					129,400
Tiger Salamander		X					129,400
Rio Grande Cutthroat		X					129,400
Boreal Owl	X(5)						580,190
Burrowing Owl						X	24,790
Ferruginous Hawk						X	24,790
Flammulated Owl			X(5)	X(5)			81,760
Fox Sparrow		X					129,400
Golden-Crowned Kinglet	X(5)						580,190
Goshawk	X(5)		X(5)	X(5)	X(5)		677,290
Lewis' Woodpecker		X	X(4&5)				172,460
Loggerhead Shrike							24,790
Olive-sided Flycatcher	X(4&5)			X(4&5)	X(4&5)		753,610
Osprey		X					1,220 ²
Pygmy Nuthatch			X(4&5)				43,060
3-Toed Woodpecker	X(4&5)			X(4&5)	X(4&5)		753,610
White-Faced Ibis		X					129,400
Marten	X(5)			X(5)	X(5)		651,570
Lynx	X (1&5)						676,070
Wolverine							1,076,430 ³
1 Reflects total acres of known riparian area 2 Reflects acres of lakes 3 Reflects acres of undeveloped areas							

Three species, black swift, dwarf shrew, and Townsend's big-eared bat, have habitat requirements that do not lend themselves to any particular LTA or structural class. As a result, there is no accurate way to find out the amount of potential habitat on the Forest.

The osprey's potential habitat acreage reflects the number of lakes on the Forest

The potential habitat shown for the wolverine reflects those acres that are within undeveloped landscapes

For some species, the primary attribute for which they would be tied to is the presence of snags. The chosen structure classes were those that have the highest likelihood of containing the necessary sizes and numbers of snags. The species are the flammulated owl, Lewis' woodpecker, olive-sided flycatcher, pygmy nuthatch, and 3-toed woodpecker.

Snags are used by a great variety of species for nesting, denning, perching, roosting, feeding, and cover. There are two broad categories of snag users. One group is identified as primary cavity nesters. These are animals that excavate the initial cavity in the snag, woodpeckers and flickers fall into this group. The other group is known as secondary cavity nesters. These animals rely on the cavities from the former group, since they rarely make their own cavities. Some common species in this group include western bluebirds, house wrens, saw-whet owls, and squirrels. Hoover and Wills (1984) calculated the number of snags needed for three potential population levels of primary cavity nesters (100%, 70%, and 40%). The average number of snags per acre was: 1.3, .93, and .53 respectively. Balda (1975) recommended a snag density of 2.2 per acre for secondary cavity nesters. He felt a minimum density would be 1.7 per acre.

About one-third of the forested cover type has been inventoried (RMRIS) to gather timber stand data. One of the attributes collected was number of snags. Because of the structure of the inventories, they are biased towards those stands that have had some level of timber harvesting. The average density of snags from these areas is 0.8 per acre. The two bird studies discussed previously were conducted in areas that had no RMRIS data and help provide a idea as to what kind of densities the other parts of the Forest have. Carter (1995) found an average of 31 snags per acre in spruce-fir and Gillihan and Carter (1996a) found an average of 8 snags per acre in mixed conifer. The studies counted snags that were eight inches or greater in diameter. It was felt that a cavity could not be built in a smaller tree (the snags under the RMRIS inventory had to be at least nine inches in diameter).

According to the most recent information, approximately 30% of the Forest's rangelands are considered in unsatisfactory condition. As Table F1 shows, three species are associated with the Western Wheatgrass LTA, a rangeland LTA. Because of how the data was gathered, it is not possible to say how many of the unsatisfactory rangelands are in the LTA. However an approximation can be made using the winter range study since much of it occurred in the LTA (see the Wildlife Section of the EIS for more information). The results indicated that only 8% of the winter range studied could be considered in satisfactory condition.

ENVIRONMENTAL CONSEQUENCES

As seen in Table F1, the species can be grouped into some general categories based upon their associated LTAs. The evaluation of the potential consequences would then focus upon the common habitat grouping. The groups would be: forested, snag dependent, riparian, and nonforested. Those species that did not lend themselves to a particular LTA are evaluated separately.

A requirement of the Forest Service Manual is that another Biological Evaluation be conducted prior to project implementation. This helps prevent potential impacts, that escape a Forest-scale analysis, from being considered and mitigated.

An analysis of the recreational impacts on wildlife was conducted and the conclusion reached was that while there was some species displacement and probable shifts in habitat use patterns (especially during hunting season) there was no evidence to suggest the current and projected levels of recreational would cause any threat to species viability. Consult the TES Animals/Viability section in the EIS for more information.

Forested Group

This group includes the boreal owl, flammulated owl, goshawk, Golden-crowned kinglet, lynx, and marten. There will be limited impacts to the forested habitats on the RGNF. Consequently, there will be only minor changes in the amount of potential habitat for these species. For a more thorough discussion, see the Fragmentation/Connectivity and TES Animal/Viability sections in the EIS.

In summary the sections showed:

On a percentage basis there will be essentially no change in the amount of late-successional forest, the amount of the RGNF in an undeveloped condition, or the amount of late-successional forest in an undeveloped condition.

The amount of late-successional forest on the RGNF is, and will remain, at the upper end of what would be biologically expected from the forested cover types.

The amount of clearcut and overstory removal harvesting will be minimal. Timber harvest activities will mimic the composition and structure of reference or "natural" landscapes.

The Forest will remain in a condition that is best described as human activity surrounded by a matrix of mature forest.

The habitat is well distributed across the landscape with no large gaps to prevent connectivity.

Recently there have been two large scale assessments completed, one for flammulated, boreal, and great gray owls (Hayward and Verner 1994), and one for marten, fisher, lynx, and wolverine (Ruggerio et al. 1994). It is important to note their conclusions reached with respect to the species' status within their ranges.

Boreal owls currently are well distributed across a large geographic range and therefore the species is not in any immediate peril in the U.S. or worldwide. There is long term concern about the reduction in habitat from even-aged timber harvesting and catastrophic fires.

While the environment for the flammulated owl has been anything but stable, it seems to be holding its own. Whether populations are secure or declining is not

known, but the species currently occupies all of its historic range in what appears to be good numbers. A crisis is not immediately at hand, and urgent measures are not needed

Changes in patterns of distribution and abundance of martens suggest that this species is not secure throughout its range. However, they also concluded the geographic range in the Rocky Mountains is apparently similar to presettlement times

Lynx populations in the western mountains of the U.S. occur at the periphery of the species' range in North America. Populations in this region, particularly those found in Wyoming, Utah, and Colorado, exist at low densities in fragmented and disjunct distributions. Given the rarity of the records and dispersal capabilities of lynx, it is possible that existing animals represent short-term residents or individuals wandering and dispersing rather than reproductively stable populations; viable lynx populations may never have occurred in historic times in the southern Rocky Mountains. The range in the western mountains has diminished over the last century, suggesting that lynx may be negatively affected by development

Wolverines in the western conterminous U.S. exist in small populations largely inaccessible. Populations in northwest Montana have the greatest likelihood of long-term persistence. The Colorado population, if it still exists, may be isolated by the Wyoming and Central Rocky Mountain Basins. A recovery evaluation should consider whether the Colorado Rocky Mountains ecoprovince historically supported self-sustaining wolverine populations

Another document which looked at the status of a species in its range was the recent review, by the Wildlife Society, of the scientific basis that led to the development of management recommendations for the goshawk in the Southwestern United States described in Reynolds et al. (1991). They noted that no evidence was presented to indicate that goshawk populations are declining, threatened or endangered in the Southwest or anywhere within its range, and found no evidence of a long-term decline in goshawk breeding populations (Braun et al. 1996).

Snag-dependent Group

The species in this group include the boreal owl, flammulated owl, Lewis' woodpecker, pygmy nuthatch, olive-sided flycatcher, and 3-toed woodpecker. The woodpeckers are considered primary cavity nesters, and the others secondary cavity nesters.

Implementation of the snag standard in timber harvest areas combined with the high snag densities found in the undeveloped areas on the Forest will result in a snag density that will still exceed the 100% potential population level for primary and secondary cavity nesters. In addition, with so many acres undergoing natural processes, fire will be able to play out its role in many cases resulting in constantly created fire-killed trees for those woodpeckers which seek them out.

This large acreage in undeveloped condition will also mitigate the potential effects of a rule change in the Occupational Safety and Health Associations's (OSHA) regulation of working around snags. The rule calls for no work taking place within two tree lengths of a hazard tree. A hazard tree is loosely defined, but could be interpreted to mean all snags. If that strict interpretation is adopted, it could result in removing most of the snags within timber harvest areas. The consequence would be small pockets of the Forest without snags. This situation would cause a loss of potential habitat. However, these areas would be small within the context of the Forest and be surrounded by the undeveloped areas which have high snag densities. As a result, the impacts would be limited.

Riparian Group

The species in this group include the boreal toad, tiger salamander, leopard frog, Rio Grande cutthroat trout, fox sparrow, and white-faced ibis. For a more thorough discussion on riparian impacts, see the Riparian section in the EIS. Briefly the discussion showed:

Management practices to protect riparian areas are included in the Plan. Condition is measured as part of stream health and range allotment assessments. The Forest goal is to keep these areas in good to high ecological condition, unless management for lower condition is needed, for example to protect a threatened or endangered species. If unacceptable conditions are encountered, management is altered to ensure recovery. Reference streams have been selected for evaluating riparian area conditions.

Alternatives allow different levels of activity and associated disturbance. In alternatives that allow more resource use, the potential risk of riparian area impacts is increased, but does not make any alternative unacceptable. All activities are addressed with appropriate mitigation to prevent degradation of natural functions and associated values. Mitigation is accomplished by properly locating facilities that concentrate use and redirecting activities that exceed site resiliency.

In particular three standards and guidelines will have the greatest influence on the riparian habitat.

The aquatic habitat should be managed to mimic reference stream conditions. The assumption is that these reference streams represent a "natural" system and as such, they provide high quality habitat for aquatic species.

A certain amount of stubble height will remain at the end of the growing season. There is the option to increase these stubble height requirements if in doing so a particular habitat objective would be reached. By restricting the amount of herbaceous forage that can be grazed there would be a concurrent restriction in the amount of woody vegetation that would be grazed. The result would be to reduce the amount of grazing that is currently happening on the woody vegetation. This should allow an increase in woody vegetation in those riparian areas that can support that type of vegetation. Consequently, there would be an increase in the condition of the riparian habitat.

The standards and design criteria from the Draft Water Conservation Practices Handbook will be implemented which have proven to be effective in protecting soil and aquatic resources.

As a result, there should be improved riparian condition, and therefore improved habitat, for all species associated with this habitat.

DOW's Draft Management Plan for the Rio Grande Cutthroat Trout sets a goal of establishing and maintaining 10 stable populations of trout on public lands. Of the 20 stream and 17 lake populations, the DOW only considers 7 of them stable.

For the most part, the lake populations are not self-sustaining because of such things as winter kill and lack of adequate spawning habitat. For the stream populations, the improvement in riparian condition would help 11 populations where habitat quality is of concern. The seven populations that have competition from the exotic trout will eventually be lost. Since the DOW has jurisdiction over population management, it is beyond the scope of this Plan to direct fish salvage efforts to sustain those seven populations. The DOW has made a commitment to maintain and expand the number of populations of Rio Grande cutthroat trout on the Forest. They have recently set up a brood stock operation on a private lake within the Forest. This will enable them to gather plenty of eggs each year for their transplant program. Unlike the past activities of building and maintaining a fish barrier to keep the cutthroat trout free from exotic fish, the focus now is on identifying areas with natural barriers. This keeps costs down and is usually more effective in keeping the exotic trout from moving upstream to compete with the cutthroat. The seven areas with exotic trout will be evaluated to see if there are any natural fish barriers. If not, it is unlikely that any more cutthroat transplanted.

There are enough streams that meet the necessary habitat parameters and have natural fish barriers that there should be no problem with reaching the population goal set in the Cutthroat Management Plan identified.

Nonforested Group

The species in this group include: the burrowing owl, ferruginous hawk, and loggerhead shrike.

One factor that stands out about this group is that the potential habitat is relatively small when compared to the acreage of the Forest. A corresponding fact of this is that these areas tend to be scattered all across the lower boundary with no large contiguous acres.

It is questionable if the Forest does indeed contain much habitat for either the burrowing owl or the Ferruginous hawk. Not only are there few prairie dog towns on the Forest, but based on the literature, the current condition of the habitat would suggest that the habitat is not suitable. The condition of the LTA has been poor for a long time since the condition of the habitat was dictated by factors which occurred long ago. Perhaps that is why there have been no sightings of either species. On the other hand, the shrike is known to breed on the Forest which implies that the existing habitat is suitable for it.

There should be improvement in the condition of the rangelands because the grazing *standard continues the practice of linking the amount of grazing use with the range condition*. The premise is that the poorer the range condition, the lighter the grazing use. The lighter grazing pressure will allow the poorer ranges to improve

Although a large portion of the potential habitat has a high potential for oil and gas, the projected level of activity is very small. For those areas with activity, there is flexibility to adjust the timing and location of the exploration work. If a full field is developed, there will be some loss of potential habitat near the field. The amount of the loss would depend upon the size of the field. Given that the LTA is small and scattered, there could be a big impact in a site specific situation. However, with the anticipated level of activity, it is highly unlikely that a field would be developed within the planning period

With the continued improvement of the rangeland conditions, it is possible that the burrowing owl and Ferruginous hawk could eventually find suitable habitat on the Forest. But given the small amount of potential habitat available, the general population of either species is not dependant upon the Forest's habitat. The shrike will continue to find conditions favorable for its nesting since the conditions will only improve for its prey.

Caves

The Townsend's big-eared bat falls into this category. The effect on potential habitat is *limited because none of the alternatives propose activities that affect caves or mines*. In addition, there is a standard that will ensure continued access, for these bats, to any mine slated for closure due to public safety reasons

Cliffs and Waterfalls

The black swift is the only species associated with cliffs and waterfalls

None of the alternatives propose projects within this habitat type, so there are no impacts to this habitat

Lakes

While there is obvious overlap with the riparian group, the reason to break lakes out separately is because of the osprey. This species is typically associated with lakes more than wetlands. The osprey is primarily a fish eater. None of the alternatives alter the existing habitat found within the Forest's lakes. The Division of Wildlife plans to continue its lake fish-stocking program. Therefore, there would no change in the amount and condition of potential habitat for the osprey

Other

The lack of knowledge about the dwarf shrew, makes it hard to assess the impacts from the *proposed action*. Given the apparent wide range of potential habitats the shrew occupies,

it could be argued that the impacts would be low since there would not be major changes in the potential habitats as a result of human activities.

Undisturbed Landscapes

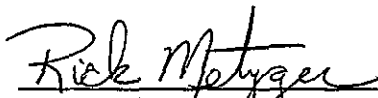
These areas were broken out because the wolverine has such a large home range that it is not tied to any particular LTA, but rather, seems to seek out areas with minimal human activity. Summarizing the information found in the TES Animals/Viability Section, large acreages of undeveloped landscapes would remain in all of the alternatives.

DETERMINATION OF EFFECTS

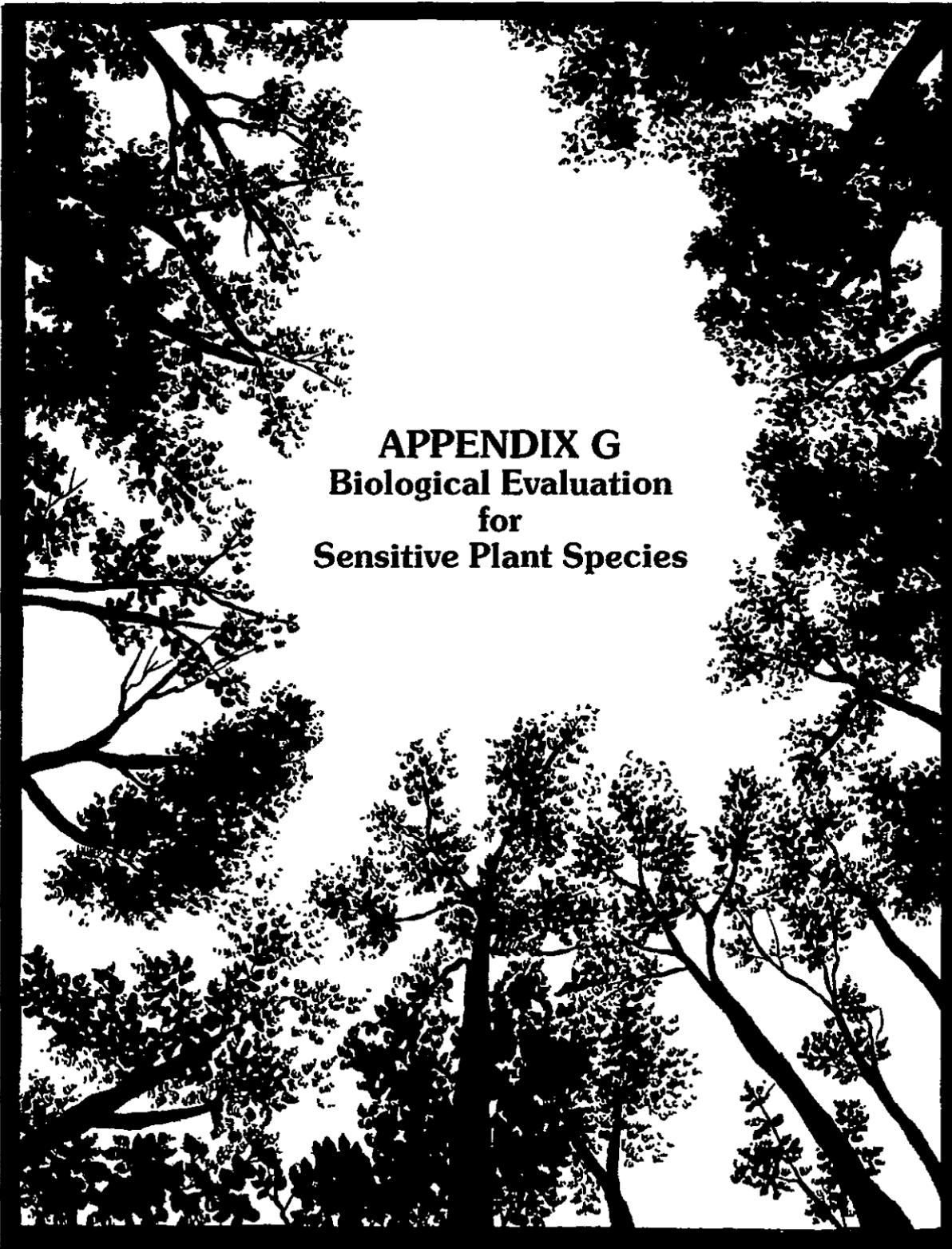
It is my determination that any of the proposed alternatives "May adversely impact individuals, but are not likely to result in a loss of viability in the Planning Area, nor cause a trend to federal listing or a loss of species viability rangewide "

The rationale for that determination is that none of the environmental consequences discussed revealed any major impacts to potential habitat. In addition, the proposed S&Gs, and the requirement of another Biological Evaluation prior to project implementation, will provide additional protection to the potential habitat.

Prepared by


Rick Metzger
Forest Biologist

10/18/96
Date



APPENDIX G
Biological Evaluation
for
Sensitive Plant Species

APPENDIX G

Biological Evaluation for Sensitive Plant Species

INTRODUCTION

The Regional Forester has identified Sensitive species for the Rocky Mountain Region (Regional Supplement 2600-94-2) This Biological Evaluation was prepared to determine the effects of carrying out the Alternatives considered as part of the Environmental Impact Statement for the Forest Land Management Plan

Sensitive species are those where there is a suspected downward trend in population and/or their habitat is being lost. The purpose of the designation is to serve as an early alert to avoid taking action that would lead to any of the species being placed on the Threatened or Endangered list. Another purpose is to maintain diversity of native plants.

There are nine Sensitive plants documented on the Rio Grande National Forest. Locations of Sensitive plants came from Forest files and records from the Colorado Natural Heritage Program (CNHP). Appendix E contains summaries of the habitats and known distributions for the nine Sensitive plant species

PROPOSED ACTION

The proposed action is the implementation of any of the Alternatives described in Chapter Two of the Final Environmental Impact Statement. Incorporated with each Alternative is a mixture of Management-area Prescriptions and a series of Standards and Guidelines (S&Gs) They describe management activity constraints needed to mitigate potential impacts to resources and guide overall management toward a desired condition. As a result, they outline protective measures that would be employed to protect Sensitive plant habitat as follows

- ☐ Activities will be managed to avoid disturbance to Sensitive species that would result in a trend toward federal listing or loss of population viability. The protection will vary depending on the species, potential for disturbance, topography, location of important habitat components and other pertinent factors
- ☐ Where newly discovered Threatened, Endangered, Proposed, or Sensitive species habitat is identified, an analysis shall be conducted to decide if any adjustments in the Forest Plan are needed
- ☐ Vegetation utilization and residue guidelines

- ❑ Establishment of Special Interest Areas (Botanical Areas) to specifically emphasize the protection of botanical values.

Biological Evaluations (BEs) are done at the project level to address the effects of proposed activities on Sensitive plants. The following are general measures that may be employed to mitigate impacts to Sensitive plants:

- reduce the impact on Sensitive plants by avoiding the plants or habitat,
- limiting the degree or size of the impact,
- reduce impacts by changing the timing,
- repair, rehabilitation, or restoration following the action,
- compensation by creating or enhancing nearby habitat, or
- alternative methods to achieve a project goal

EFFECTS ANALYSIS

Table G-1 displays the Sensitive plants reported on the RGNF, by general vegetation zone and general habitat

Table G-1. Vegetation zone, and general habitat for the Sensitive plants reported on the RGNF

Scientific Name	Common Name	Vegetation Zone ^{1/}	General Habitat ^{2/}
<i>Astragalus ripleyi</i>	Ripley milkvetch	M	open forestland
<i>Botrychium echo</i>	echo moonwort	S	open forestland
<i>Botrychium pallidum</i>	pale moonwort	S	open forestland
<i>Draba smithii</i>	Smith whitlow-grass	S	rocky
<i>Eriogonum brandegei</i>	Brandegee wild buckwheat	F	open forestland
<i>Eriophorum altaicum</i> var <i>neogaeum</i>	Altai cottongrass	A	wetland
<i>Gilia penstemonoides</i>	Black Canyon gilia	M	rocky
<i>Machaeranthera coloradoensis</i>	Colorado tansy-aster	S	grassland
<i>Neoparrya lithophila</i>	rock-loving neoparrya	F	rocky
<p>1/ This is the documented vegetation zone where the plant was found on the RGNF. Please note that some plants do not align themselves strictly to one zone.</p> <p>A = Alpine Zone -- >= 11,800 feet S = Subalpine Zone -- 10,000 - 11,800 feet</p> <p>M = Montane Zone -- 8,000 - 10,000 feet F = Foothills Zone -- <= 8,000 feet</p>			
<p>2/ This is the general habitat where the plant was found on the RGNF. Please note that some plants do not align themselves to one habitat.</p> <p>Grassland -- grass-dominated lands</p> <p>Shrubland -- shrub-dominated lands</p> <p>Forestland -- forest-dominated lands</p> <p>Open -- a modifier for forestland meaning park-like and very sparse tree canopy coverage</p> <p>Wetland -- water saturated at some time during the growing season sufficient to influence plant composition</p> <p>Rocky -- means rock outcrop, scree, talus, or fell-field</p>			

Table G-2 displays a summary of Sensitive plant species grouped by habitats and vegetation zones. The largest number of Sensitive plant occurrences is in open forestland habitat and in the subalpine vegetation zone

Table G-2. Summary of the number of Sensitive plant species grouped by habitats and vegetation zones

GENERAL HABITAT ^{2/}	VEGETATION ZONE ^{1/}				TOTAL
	ALPINE	SUBALPINE	MONTANE	FOOTHILLS	
Grassland	0	1	0	0	1
Shrubland	0	0	0	0	0
Forestland	0	0	0	0	0
Open forestland	0	2	1	1	4
Rocky	0	1	1	1	3
Wetland	1	0	0	0	1
TOTAL	1	4	2	2	9
^{1/} See footnote for Table G-1 ^{2/} See footnote for Table G-1					

An occurrence context is provided next for each Sensitive plant species on the Forest by showing the number of known records on the RGNF, Tri-section, and Province (Table G-3) The purpose of this table is to see if any Sensitive plants occur only on the RGNF, based on available information

Table G-3. Number of population occurrences of Sensitive plants on the RGNF, Tri-section, and Province

SENSITIVE PLANT SPECIES	NUMBER OF OCCURRENCES			RGNF ABUNDANCE PERCENT ^{1/}
	PROVINCE	TRI-SECTION	RGNF	
<i>Astragalus ripleyi</i>	42	42	9	21%
<i>Botrychium echo</i>	17	4	1	25%
<i>Botrychium pallidum</i>	5	3	1	33%
<i>Draba smithii</i>	8	8	5	63%
<i>Erigonum brandegee</i>	8	3	1	33%
<i>Ernophorum altaicum</i> var <i>neogaeum</i>	12	10	2	20%
<i>Gilia penstemonoides</i>	Unknown	22	2	9%
<i>Ernophorum altaicum</i> var <i>neogaeum</i>	Unknown	15	2	13%
<i>Neoparrya lithophila</i>	12	11	2	18%
^{1/} RGNF occurrence divided by Tri-section occurrence				

Plants with a high RGNF occurrence compared with the Tri-section could suggest a habitat preference for the RGNF. None of the plants approach 100% abundance. None of the above species' geographic distribution is limited to only one Colorado county, except *Astragalus ripleyi*. This plant is an endemic from northern New Mexico and southern Colorado, and is not restricted to just the RGNF

Thus, none of the Sensitive plants show any habitat specificity restricted only to the RGNF. Many of these plants have low reported population occurrences on the Forest, but this is probably attributed to low search effort on the Forest. See Appendix E for a listing of known occurrences, by Colorado counties, for each Sensitive plant species.

Appendix E provides a global and state rarity ranking for all Sensitive plants. The ranking system follows CNHP methodology and helps describe how rare (or relatively common) each plant species is for the state and for the world. The global ranking provides a good estimate of how rare a plant is currently believed to be, based on known occurrence data. Five Sensitive plants have global rankings of G2 (imperiled globally -- see Appendix E for full definition) or rarer. Sensitive plants meeting this criterion are as follows: 1) *Botrychium echo*, 2) *Botrychium pallidum*, 3) *Eriogonum brandegei*, 4) *Machaeranthera coloradoensis*, and 4) *Neoparrya lithophila*. An evaluation for this specific group of plants follows. Two questions are relevant for these species, one, are any of these plants restricted to the RGNF, and two, are any of these plants restricted to highly specialized habitat conditions?

The first question is answered by looking at the Colorado county distribution occurrence records for these plants (shown in Appendix E). Upon inspection, all of them have reported occurrences in other counties off the RGNF.

The second question asks if any of the plants require very specialized habitat requirements. Each of the four species listed above is assessed below as follows:

Botrychium echo and *Botrychium pallidum* occur in Engelmann Spruce on Mountain Slopes Landtype Association (LTA 1) with relatively open canopy. There is over 900,000 acres of this LTA on the Forest. In addition, much of the open spruce cover type in the Tri-section provides potential habitat. These species are extremely small and difficult to see. This, in part, probably explains the low occurrence records.

Eriogonum brandegei probably does not occur on the Forest. The reported location on the RGNF does not contain suitable habitat for this plant. The location description from the reported occurrence record is judged to be in error (O'Kane 1988). Therefore, this analysis will consider *E. brandegei* as not occurring on the RGNF.

Machaeranthera coloradoensis is found in the more gravelly habitats of Arizona Fescue on Mountain Slopes Landtype Association (LTA 8) and Thurber Fescue on Mountain Slopes Landtype Association (LTA 9). It is an endemic species of south-central Wyoming and western Colorado. Harrington (1954) reports this plant occurring in south-central, west-central, and southwestern parts of Colorado from 9,000 to 11,000 feet.

Neoparrya lithophila is found in the Pinyon on Mountain Slopes Landtype Association (LTA 6), but it appears to be more restrictive in habitat requirements. It

prefers late tertiary volcanic dikes, lava flows, and igneous outcrops. It is endemic to south-central Colorado.

Thus, *Neoparrya lithophila* is probably the G2 or rarer species with the most restrictive habitat of this group. Because the habitat is rocky, this species is at low risk from habitat impact and alteration.

The next major question to ask is whether there are any proposed activities, by Alternative, that will have a negative impact on any of the Sensitive plant species? For a more thorough discussion, see the TES plant section in Chapter Three of this document. A summary of the conclusions from that section follows.

1) Timber Harvest -- The majority of the potential timber harvest, regardless of Alternative, would occur in the subalpine zone. There are no Sensitive plant species primarily associated with subalpine closed-canopy forestland. Those Sensitive plants associated with open canopy forestland or rocky habitat would be at very low risk of habitat alteration. There are no Sensitive plants associated primarily with closed-canopy forestland habitat in the montane zone. This extremely low level of potential disturbance, coupled with site-specific Biological Evaluations and appropriate mitigation measures, should have little or no impact on Sensitive plants.

2) Livestock Grazing -- Plants strongly associated with rocky habitats are assumed to be relatively unavailable to livestock grazing. Thus, *Draba smithii*, *Gilia penstemonoides*, and *Neoparrya lithophila* are probably at very low risk from impact by livestock grazing. A specific assessment for the remaining Sensitive plants follows.

Astragalus riplei

This plant is found in open-canopy forestland in the Montane Zone. Plants appear to be grazed by livestock, deer, elk, and rabbits. There also appears to be significant insect use of this plant (harvester ants, tree hoppers, and others). In areas receiving heavy grazing pressure, robust plants may be found in the protection of shrub crowns (CNHP 1994). Not all known sites are receiving livestock grazing on the RGNF. This plant has been exposed to livestock grazing for over 100 years and it is still present in the landscape. It appears to be a mid-seral species requiring some level of disturbance for long-term perpetuation. There could be some risk to this plant through excessive utilization, trampling, and soil compaction under heavy stocking conditions. It is doubtful that proper livestock grazing is adversely impacting the long-term existence of this plant. However, the RGNF is currently conducting a monitoring program cooperatively with the Bureau of Land Management, the State of Colorado, and Colorado State University to assess the impacts of livestock grazing on this plant.

Botrychium echo

This species is typically found in gravelly soils in relatively open Engelmann Spruce on Mountain Slopes Landtype.

Association (LTA 1). There is an abundance of this habitat on the Forest. Peter Root's opinion is that rabbits and voles probably graze *Botrychium* species, but he is not aware of livestock grazing this genus. The above-ground portion of the plant can be pulled out of the ground without killing the plant (personal communication July 14, 1994 between Peter Root, *Botrychium* specialist, and Dean Erhard). There could be some risk of trampling and soil compaction under heavy stocking conditions. It is unlikely that this plant will be adversely impacted by proper livestock grazing.

Botrychium pallidum

See *Botrychium echo*, since the same information applies

Eriogonum brandegei

This plant is found in sagebrush and pinyon/juniper communities on limestone and shale soils (CNHP 1994). It is highly doubtful that this plant occurs on the RGNF (O'Kane 1988). Therefore, a risk of grazing impact on this species is not assessed here.

Eriophorum altaicum
var *neogaeum*

This plant occurs in wet habitats in the alpine (CNHP 1994). These plants are found in standing water on the RGNF. There is an abundance of alpine habitat (LTA 4) with many potential areas capable of supporting this species. Many alpine landscapes are not currently grazed by livestock. This species is probably somewhat unavailable to livestock, depending on the depth of water. There could be some risk to the plant through excessive utilization, trampling, and soil compaction under heavy stocking conditions. Since some of the habitat is not conducive to grazing and habitat does not appear to be limited, it is doubtful that proper grazing on the RGNF will lead to a detrimental impact on this species.

Machaeranthera coloradoensis

This plant is a low, prostrate, mat-forming plant found on gravelly sites. It is found in the more gravelly habitats of Arizona Fescue on Mountain Slopes Landtype Association (LTA 8) and Thurber Fescue on Mountain Slopes Landtype Association (LTA 9). The plant appears to be somewhat unpalatable (Fertig 1994). Also, the sparseness of the habitat probably does not encourage animal use. Thus, there do not appear to be immediate threats to this species. There could be some risk of trampling and soil compaction under heavy stocking conditions.